VALVE

the magazine of astounding sound

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extreme FM-3 mod

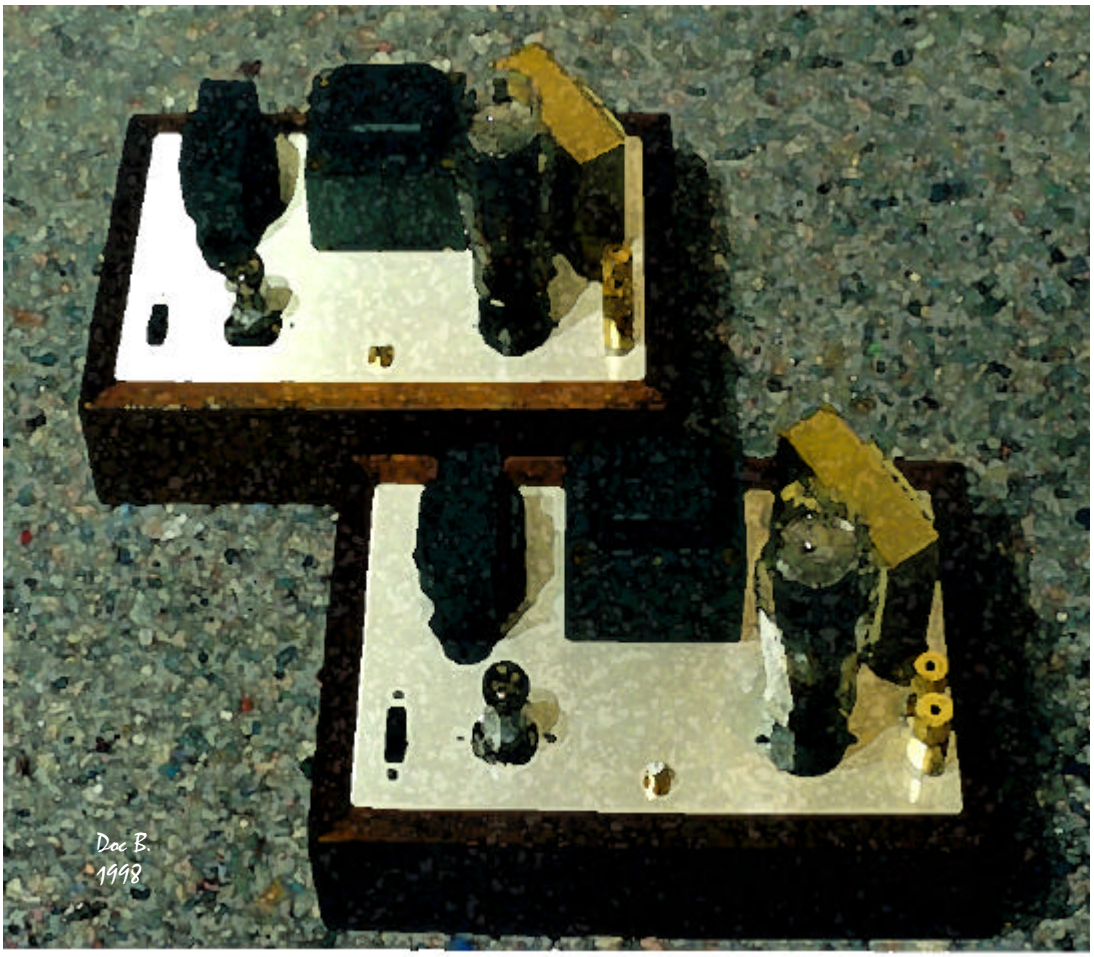
Boulders -
a turntable odyssey, part two

Doc B.-
C4S ing the S.E.X. amp

Epstein -
a visit with Fi-s Don Garber

Brainiac -
heavy metal

volume 6 number 1 1999



Paraglow

a sonic masterpiece by Electronic Tonalities

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Editor and Publisher
Dan Dr. Bottlehead Schmalle
Chief Administrator
Queen Eileen Schmalle
Resident Smart Guy and Technical Editor
Paul Braniac Joppa
Graphic Design
Bruce Papa Borley
Resident Hot Iron and Dr. B's Bodyguard
John Smoothplate Tucker
Big gun OEM advisor
Michael Airgap LaFevre
Guru's guru
John Buddha Camille
Contributing Editors
David Full Track Dintenfass
Crazy Eric Lenius

Our mailing address:
VALVE
P.O. Box 2786
Poulsbo, WA 98370
by phone: 360-697-1936
business hours: 9-5 PST, Mon -Fri
fax: 360-697-3348
e-mail - bottlehead@bottlehead.com
website - http://www.bottlehead.com

editor s thing

Once again we greet you in a new format, as we have upon occasion over the years (has it been five already?!). Time and technology march on, and we flounder to keep up.
Welcome to the first edition of the new electronically published VALVE. The magazine has been produced with the intention that it will print well, and we encourage you to try printing a hard copy from the .PDF file.
We had hoped to continue to be able to put out VALVE in both electronic and hardcopy formats, but costs have been rising and we just can t handle the expense involved in putting out printed issues of VALVE anymore. But- on the bright side, subscriptions are a thing of the past. VALVE will appear each month, downloadable for free at bottlehead.com.
Yup, for free.

Along with creating a new downloadable issues throughout the year, we will be changing the way we package our back issues. We have been taking a great deal of time to scan and convert our oldest issues, which were pasted up in the traditional fashion, and also to convert our later electronically published issues all into Acrobat .PDF format. We hope to have them all available on CD-ROMs in the next month or so. The 1999 issues will also be available on CD ROM in December of 1999, in case you miss any issues before they are taken down from bottlehead.com and replaced by a new issue during the year.

What else is new for 99?

A new website look - hopefully on your way to finding this issue you found our new website. After doing a nice job of getting bottlehead.com up and running, Dave Stagner has handed the reins over to my father-in-law, Bruce Borley. Bruce has many years of experience as a graphic designer, and consequently we will be getting a pretty hip makeover as the months progress.

New digs - we re outgrowing our disorganized home orifice setup that we ve been working in for the past seven years, and this year we will being remodeling to make us more efficient. The ol basement workshop will be revamped to include the office that up to now has taken over our family room and also a new kit packing facility.

And thanks to a wonderful Xmas gift of cash from the local VALVE members, instigated by Richard Riley and Paul Joppa, we will begin construction on our long awaited new listening room, to be built in the free standing 12 x20 garage that has been the recycling receptacle at Bottlehead ranch for the last 12 years. Thanks again for your generosity guys, Paul was tickled to see that for the first time since he s known me I was speechless. Bottlehead is taking trips to the recycle center daily and he s almost found the garage floor. We ll cover the adventure of putting this thing together in future issues.

Don t let the blue smoke out,

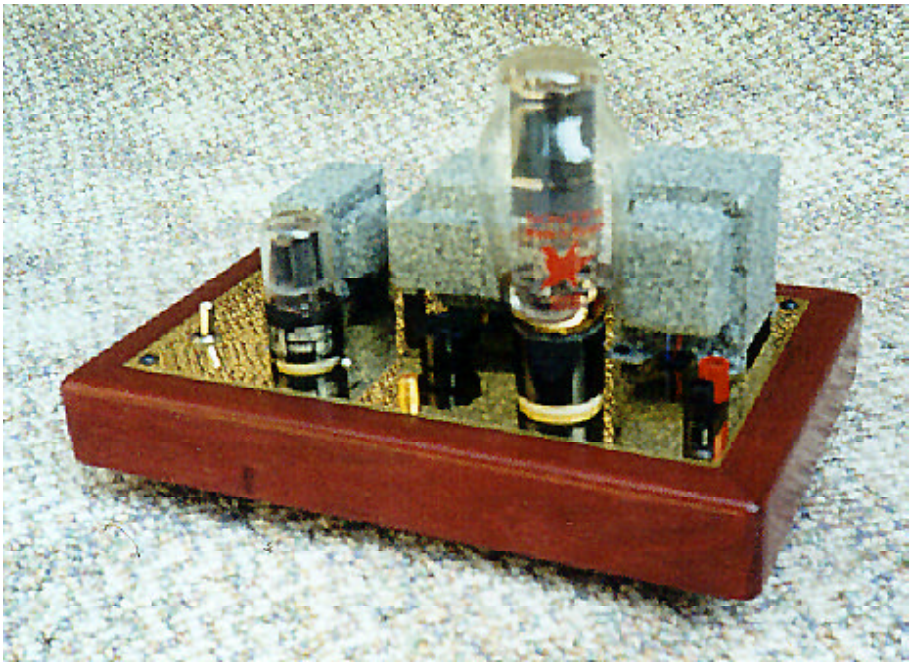
Doc B.

on the cover

Ray Kuehlthau sent us this photo of his latest woody maker, a two chassis amp based on the now famous Single Ended Direct Coupled Active Loaded Parallel Feed 45 amp from October 97 VALVE.

This two chassis stunner features carbon fiber chassis plates, zebrawood bases, brass bottom plates, MagneQuest parafeed iron, the brass channel frames of which Ray polished, and the rest of which he shot with faux granite finish.

Below is another of Ray s projects, this one his Paul Joppa 300B S.E.X. amp mod. This guy can crank out gorgeous projects like nobody.



NEW EXOTICA FROM FIRST IMPRESSION MUSIC

FIM CD019 Favorite Chinese Instrumentals

The Jin Ying Soloists

1 Like Wave Again The Sand (Pipa solo with ensemble) 4:36 2 Singing the Night among Fishing Boats (Jung solo) 4:15 3 Night (Percussion ensemble) 5:54 4 Love Song Of The Grassland (Tung-hsiao with ensemble) 2:34 5 Ducks Quacking (Percussion ensemble) 4:00 6 Love At The Fair (Er-hu solo with ensemble) 5:04 7 The Fishing Song (Ba-woo solo with ensemble) 4:53 8 Happy Reunion (Xylophone solo with ensemble) 2:55 9 Chinese Martial Art (Emsemble) 1:43 10 The Flowing Stream (Er-hu solo with Yang chin) 8:25 11 Spenpadei Folksong (Yang-chin solo with ensemble) 4:32 12 Autumn Moon (Er-hu solo with ensemble) 7:06 13 Moonlight Over The Spring River (ensemble) 9:22 14 Variation On Yang City Tune (Ku-jung solo) 5:36

FIM CD020 A Vocal Tribute to Ben Webster

Jacintha, Vocal

Teddy Edwards, tenor sax; Kei Akagi, piano; Darek Oles, bass; Larance Marable, drums

1 Georgia On My Mind (Gorrell-Carmichael/BMI) 5:19 2 The Look Of Love (Baccharach-David/ASCAP) 4:08 3 Danny Boy (Traditional) 7:26 4 Somewhere Over The Rainbow (Harburg-Allen/ASCAP) 9:43 5 Startdust (Parish-Carmichael/ASCAP) 6:40 6 In The Wee Small Hours Of Morning (Hillard-Mann/ASCAP) 4:15 7 Tenderly (Lawrence-Gross/ASCAP) 5:25 8 Our Love Is Here To Stay (George & Ira Gershwin/ASCAP) 3:19 9 How Long Has This Been Going On? (George & Ira Gershwin/ASCAP) 5:28 10 Pennies From Heaven (Burke-Johnston/ASCAP) 3:12

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Buddhafying the Dyna FM-3

By John Buddha Camille

You guys who know Buddha also know I let a djinni out of the bottle when I asked him for a few simple ideas on modding a little 'ol FM-3. Hang on to your hats with this one bottleheads, by the time Buddha gets through with you, you'll not only have the meanest FM-3 in town, you'll have the cleanest tubes too. - Doc B.

Dear Dr. R sub g (R_g),
Was very amused at the third issue of V . Your new subtitle bears out the caliber of your readership. *(Buddha is of course referring to the unending string of corrections I got regarding that dumb grid resistor I left on the output tube in the Blues Master article - B.)*

The FM-3 has turned into a real challenge. My thoughts of hot-rodding the tuner and IF strips were dashed by the wide open construction of the unit. Using higher g_m tubes for the mixer and IF strips was not possible due to the lack of shielding.

Above a certain total gain point the RF-IF strip takes off and will oscillate at around 1 0 7 MHz, the tenth harmonic of the IF. The feedback path is primarily through radiation from the last IF stage back through the RF stage grid circuit, in concert with direct conduction through the B+ and heater circuits. There is also a lot of direct radiation above chassis from tubes and the mickey mouse tube and IF can shields. This problem prevented me from getting 60 dB plus of limiting on noise alone by using hotter tubes in the IF.

I did achieve a happy balance of gains between the RF and IF that permits better limiting, slightly increased total gain, and much better noise figure with the 6DJ8 front end. Several college stations thirty to forty miles way now come in full quieting with a 3 foot clip lead antenna.

Eventually I hope to fully shield the RF section and possibly the bottom of the IF with proper interstage shielding and tons of bulkhead feed-throughs. I did cheat and use button mica caps on the RF board while trying to calm oscillations. These caps get the RF off of the lower cathode and upper grid and of course increased RF gain considerably. This required lowering the gain on the IF strip. This was done by lowering plate and screen voltages, which had the added benefit of providing better limiting. Virtually any signal will now produce a limited $4V_{pk\text{-}pk}$ signal on the plate of V-6. A slight bit of AM ing is still visible on positive peaks, however. Before modding, AM was significant on both positive and negative peaks. The beast is really starting to sound solid.

I have not had time to redo the first audio stage, V-7, and the audio output stage V-72. Plan to use a 5687 for V-7 and 12B4 s for V-72. Of course, C4S s will be used for cathode and plate follower feedback on the output. Will probably change the volume control to a 6dB stepped attenuator for better high frequency response.

The present 19,38 and 67kHz attenuation really sucks. Plan to use plenty of LC traps and filtering here, along with a proper de-emphasis filter. May need a cathode follower to drive these filters properly. The present system has a lot of 38 kHz on the output and tons of 67 kHz SCA on some stations.

Hum has always been a problem on my unit. Got rid of about 95% of it with additional filtering and direct wiring the primary power. Putting 120 VAC (to the on-off switch) within 1/2 inch of the first audio stage is not very cool. Am planning to eventually move the power supply off chassis and DC everything in a large audio visual console I had built in the Phillipines back in the 60 s. The wood, Nara, is too hard to work so I ll have to stick with the heavily modded stuff that will fit the holes on the cabinet work.

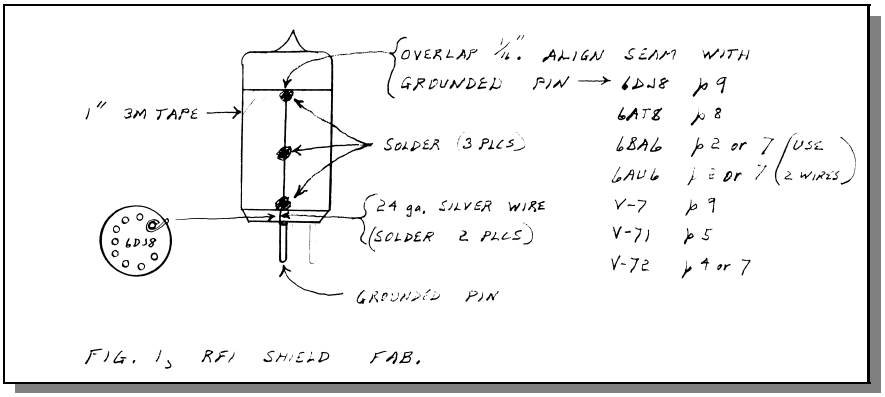


FIG. 1, RFI SHIELD FAB.

Tweaks that might be applicable to the experimenter

RF-IF Tube Shielding

The original tube shields are tube killers. I had replaced the tin can shields with IERC style shields when the unit was built back in the early 60 s. All tubes still have plenty of emmision with probably 100K hours of use. These shields are still hot with RF however, as the original ground strip corrodes pretty quick. A better answer is my combination tube shield/microphonic attenuator. This process should be used on all tubes in the set, especially the RF-IF tubes. Some folks might not like the sonics when this technique is used on the audio tubes because much of the reverb is lost...

Procedure

1 Select a new tube that checks way over good.
2 Wire brush pins until shiny with a gun bore brush chucked up in a drill motor or Dremel tool. Practice on an old tube until you figure it out.
3 Wash tube thoroughly with tooth brush and 409. Rinse and blow dry. Do not touch pins with fingers again. We re talking clean room plastic gloves here (food handler gloves are cheaper)
4 Wrap one layer of 1 3M foil shielding tape around tube and solder the seam in several places. Connect shield to the appropriate pin with 24 ga. wire wrap wire, see figure 1. The RFI tape (Digi-Key 3M1181C) is pretty pricey but will be a lifetime supply for most experimenters. I use tons of it for ground planes, power busses, shielding, etc. The stuff is severly addictive.
5 Clean rosin from all solder points with multiple Q-tips and anhydrous alcohol (Caig Caikleen) or toluene. This process must be repeated several times in order to remove all film traces.
6 Wash tube again with 409 and toothbrush (especially around tube pins). Rinse and blow dry. Blow dry is important in order to prevent leakage from water rings from solutes. Do not try to wipe dry.
7 Mask tube pins (use blue 3M masking tape) and shoot tube with flat black Krylon. The paint and copper drop envelope temperatures, significantly increasing tube life. The glass/adhesive/copper composite reduces microphonic ringing measurably. Note: for those using regular masking tape - clean adhesive off of tube pins with Q-tips saturated with Goof-Off. Then degrease with 409, etc.
8 Chuck one half of a Q-tip in a drill motor and add a small drop of Caig Pro-Gold to the cotton. Use this rotary buffer to polish tube pins. Repest process with clean Q-tips until pins produce no more black deposits on cotton. Surprise, surprise, you thought they were clean.

Note: A short lead may be soldered to the copper shield and run to the nearest analog ground when all tube pins are floating. Where necessary, a 1/16 hole may be drilled in the chassis for this ground connection. RF-IF and other non-audio signal tube shields may be returned to a chassis mounted solder lug, a ground plane or a ground buss. Make the connection short and sweet.

IF Transformer shielding

The IF can mounting lugs do not make a serious electrical connection to the aluminum can. All of my cans were initially hot with RF. Physical movement of the can would also produce intermittent contact and detuning of the transformer. The IF transformers were removed for overhaul and clean-up. While I was at it, the winding assemblies were also removed from the cans and the tank capacitors were replaced , and all internal solder joints were sucked dry and resoldered. Several joints looked suspicious where the magnet wire insulation had not been volitized completely. In addition, several windings had broken loose from the wax tie down process. The wax was removed with a slightly warm solder iron tip and the wire was rewound in place and recoated with the wax removed previously. The warm solder iron can be used to remelt the wax blob onto the winding and the coil former. A step by step follows:

1 Witness mark IF cans and circuit board with a scratch awl.prior to removal. The green alignment mark will go away later. Early cans had a slot punched into the top of the can and this will suffice.

2 Remove solder from board with solder sucker (6 places) and gently rock the can around the clock as joints are heated in succession until the can is free.

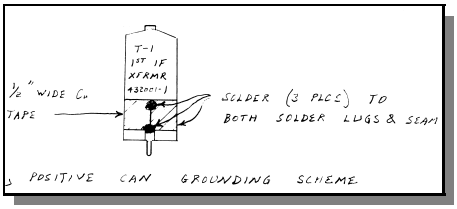
3 Witness mark the can and the coil assembly. A green dot may or may not still exist an the winding frame as an alignment marker, just make sure you get it right. For those who are reading the instructions after the fact, the primary winding is on the bottom next to the tank capacitors, see schematic symbology.

4 Number each can in accordance with its circuit location with the scratch awl, i.e., T-1 would be numbered 43201-1, T-2 would be dash 2, etc.

5 Flatten the four coil frame mounting indentations in the can with the needle nose pliers and gently remove the winding assembly from the can. Done right, the winding can be pulled out with finger pressure. Don t grip the solder lugs with pliers and pull or you may have a real fabrication problem - the plastic frame is brittle.

6 Polish the can with 409 and a piece of 3M Scotchbrite. The tin plated steel mounting lugs should be brite for later soldering. rinse and blow dry.

7 Wrap one turn of 1/2 wide copper tape around the can so that approximately 1/2 of the mounting lug is covered. Solder the copper to both lugs and tack the top of the seam, see figure 2.

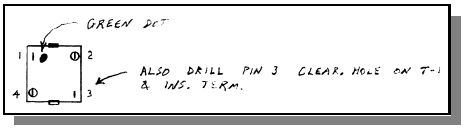


8 Remove rosin from solder joints and degrease with 409. Rinse and blow dry.

9 Shoot can with Krylon to forstall galvanic action. Flat black is best for tube life.

10 Clip out the 22 pf disc capacitor from the primary side of the transformer (lower winding) and replace with a 22 pF/N750 disc ceramic, DIGI-KEY 1305PH. When soldering the new part into the circuit, first wrap the leads around the solder joints for the coils leads. This technique will possibly solve a bad joint existant since the original manufacture. Remove iron as soon as the solder flows as the coil frame plastic is pretty poor.

11 Clip out the 10pF disc capacitor attached to the secondary terminals. Replace with a Phillips 10 pF /N750 disc DIGI-KEY 1301PH observing the above cautions.



12 Measure coil resistance after modification. Proper primary resistance is 0.75Ω and the secondary resistance is 0.78Ω.

13 Align witness marks on the IF can and the coil assembly and insert coil assembly into the can. Insure coil form is fully seated in the circular boss on the top of the can.

14 Use awl to indent the can back into the grooves in the coil assembly base frame (four places).

15 Place 0.1 in. length of small teflon tubing or wire insulation over pins 2 and 4 of the IF can.

16 Drill clearance holes in PC boards at the pins 2 and 4 locations for the above teflon insulation. (typical 1/16 - 2 places per transformer). New wiring will lift RF hot wiring off the lossy PC board material

17 Strip PC board solder pads arpund these holes and lift trace off board back to the plate or coupling cap solder pad. Apply soldering iron to the plate lead or coupling cap and they may be lifted off the board in one fell swoop. The idea is to get as much of these RF leads as possible off the crummy board material and build a decent Rf transmission line. See fig. 3. Another aim is to reduce circuit Q and widen bandwidth. The direct wiring spec d also reduces radiation effects.

Tube Sockets

The tubes sockets used in the FM-3 are a disaster. Each socket required a half dozen round toothpicks dipped in Pro-Gold to remove corrosion, etc. Twirl the picks in the pin contacts until they come away clean

Grounding Tuning Cap Shaft

The tuning shaft is fairly hot with RF and needs to be positively grounded. I used the old ham radio trick of fabbing a clockwork spring buss between the shaft and the shield. The shield around the variable cap also needs to be tack soldered to the chassis every inch. This process is fairly easy when the filter cap (C-32) is replaced. See next page.

RF Frequency Shift

Joe Roberts mentioned that the FM-3 is well known for tuning instability, something I have never encountered. Having done a lot of VHF/UHF work, I ve always been amazed how stable the thing is. Well, the palmprint on the forehead occured when thumbing

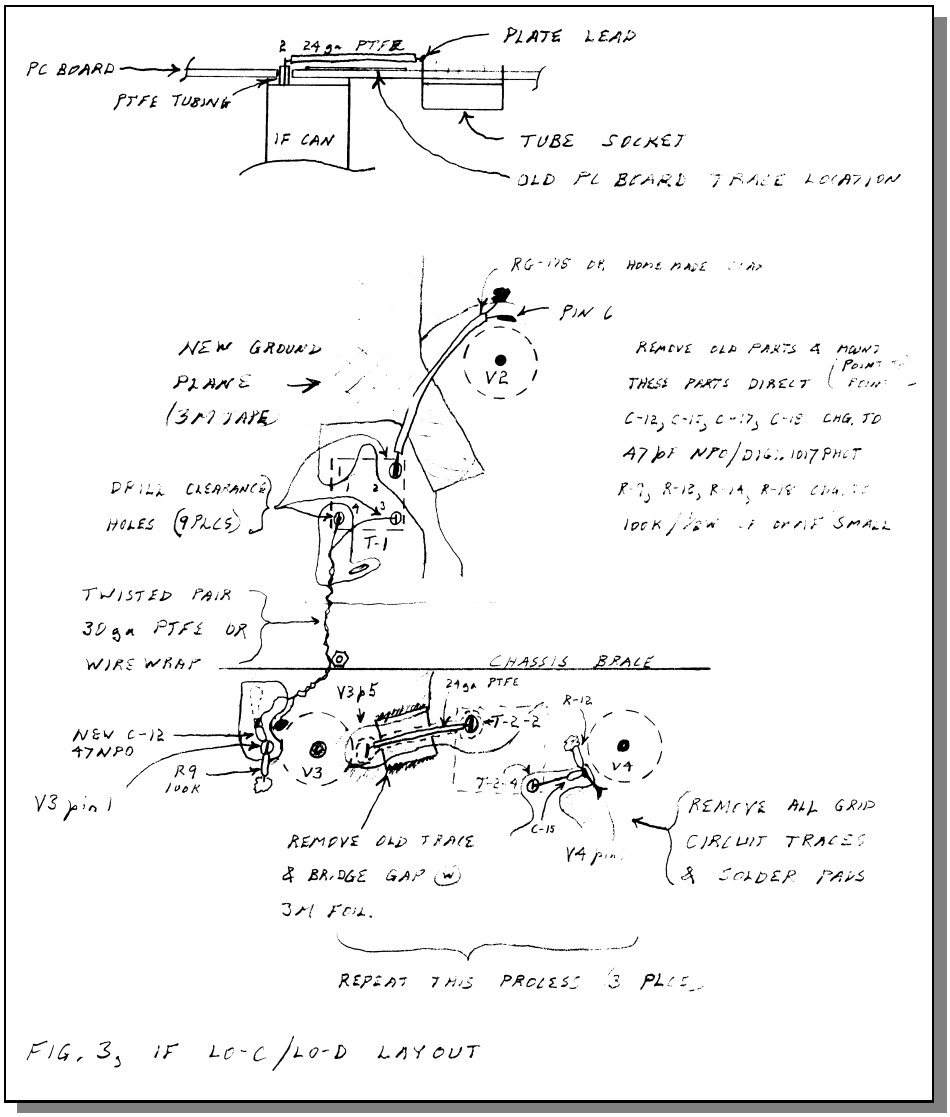
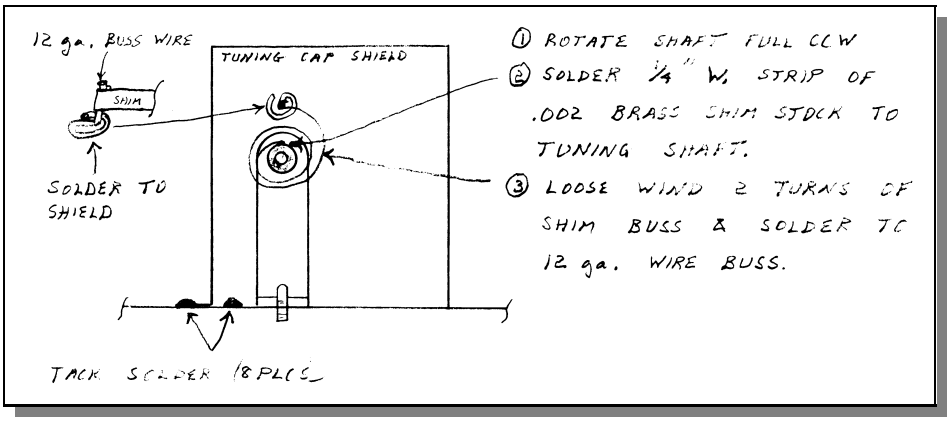


FIG. 3, IF LO-C/LO-D LAYOUT



the through the assembly manual and seeing the real C-8. I had replaced the cheapass ceramic trimmer with a Johanson air variable when I built the thing, so I had experienced no problems. Digi-Key carries the Sprague-Goodman line of trimmer caps that should work well. I used a style 9, 1-10pF cap. pn SG4004. Looks like a good fit. Surplus is better.

This type of cap, along with the button mica feedthrus, can be found in those old RF assemblies sold by the pound at the flea market. I paid 50 cents for a filter box that contained 8 sapphire insulated Johansons about a year ago. Samo, samo on bulkhead, ceramic, feedthrus such as the SCI s sold by Newark, p 151. Old TV tuners that sell for a buck or two are usually filled with feedthrus. Will need a capacitance checker with these since some are 2pF feedthrus for signal leads - most are 470 to 1500 pF for power leads and bypasses.

Other mods

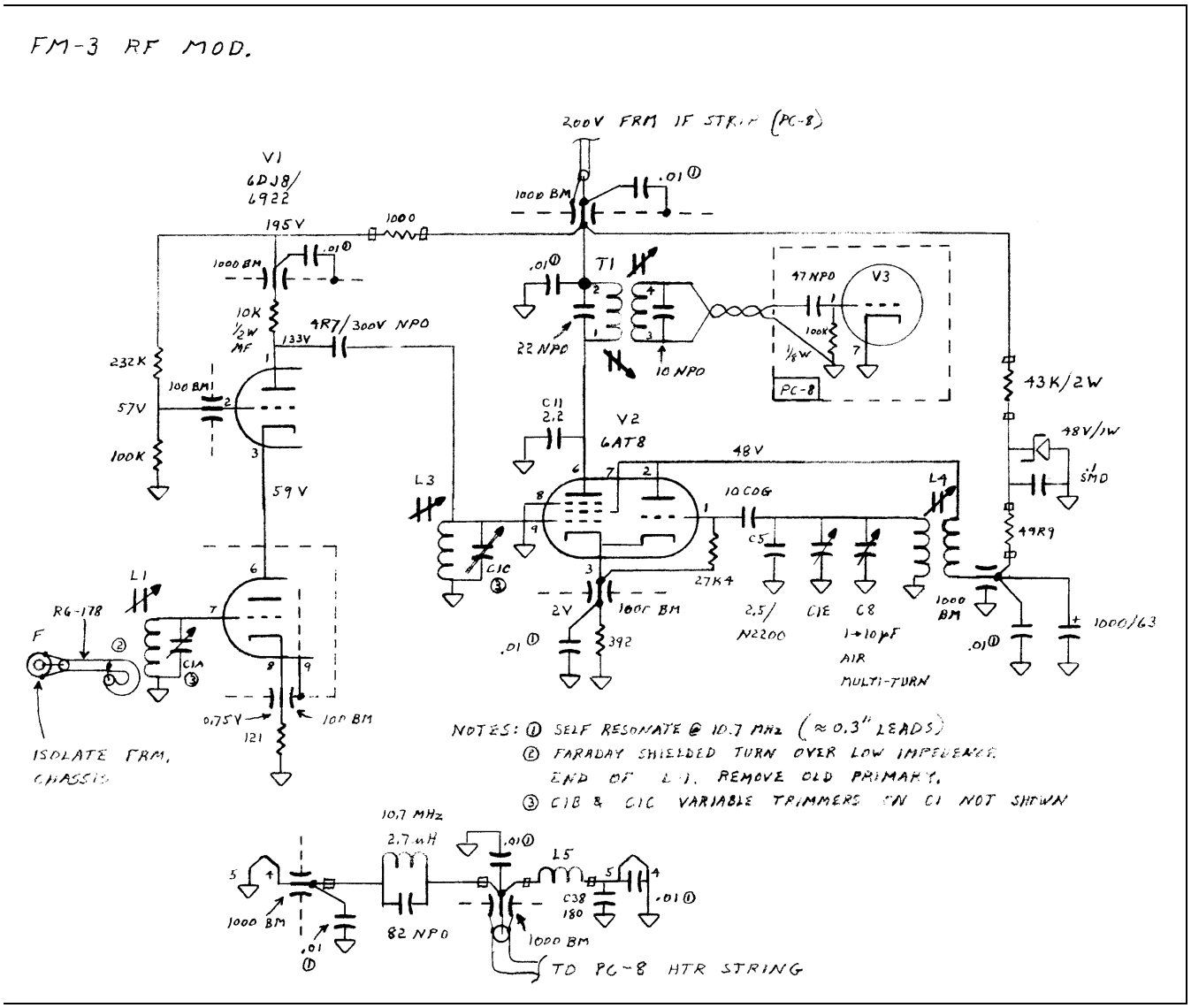
1 The HP 5082-2810 diodes also work well for the demultiplex circuit and they are a helluvalot easier to match. I am going to put the 47K resistors and the diodes in the can for T-73. Leads are too long the way they are presently scattered over the PC board.

2 The whole de-mux board needs to be replaced with an FR-4 proto board with ground plane. Will probably steal the design for a good de-mux from a Fisher or something highly acclaimed.

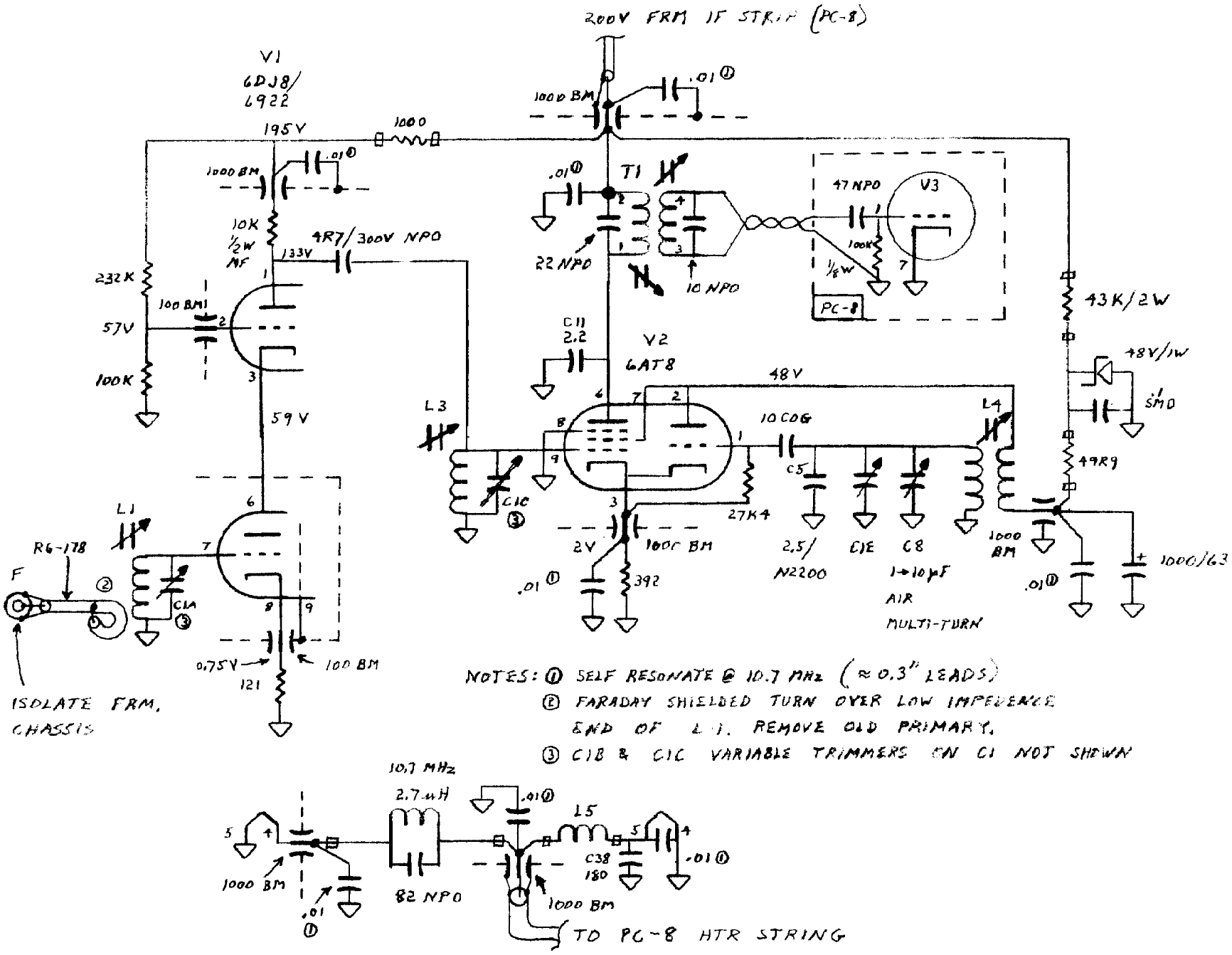
3 Might move V-7 over to the de-mux board and put the whole thing in a die-cast box.

4 You are right getting rid of the six for a nickel parts on the rear deck.(*I suggested getting rid of the crummy antenna connector screws and installing a nice F connector - B.*) I am going to BNC on audio stuff.

Well, enough B.S. for a while -



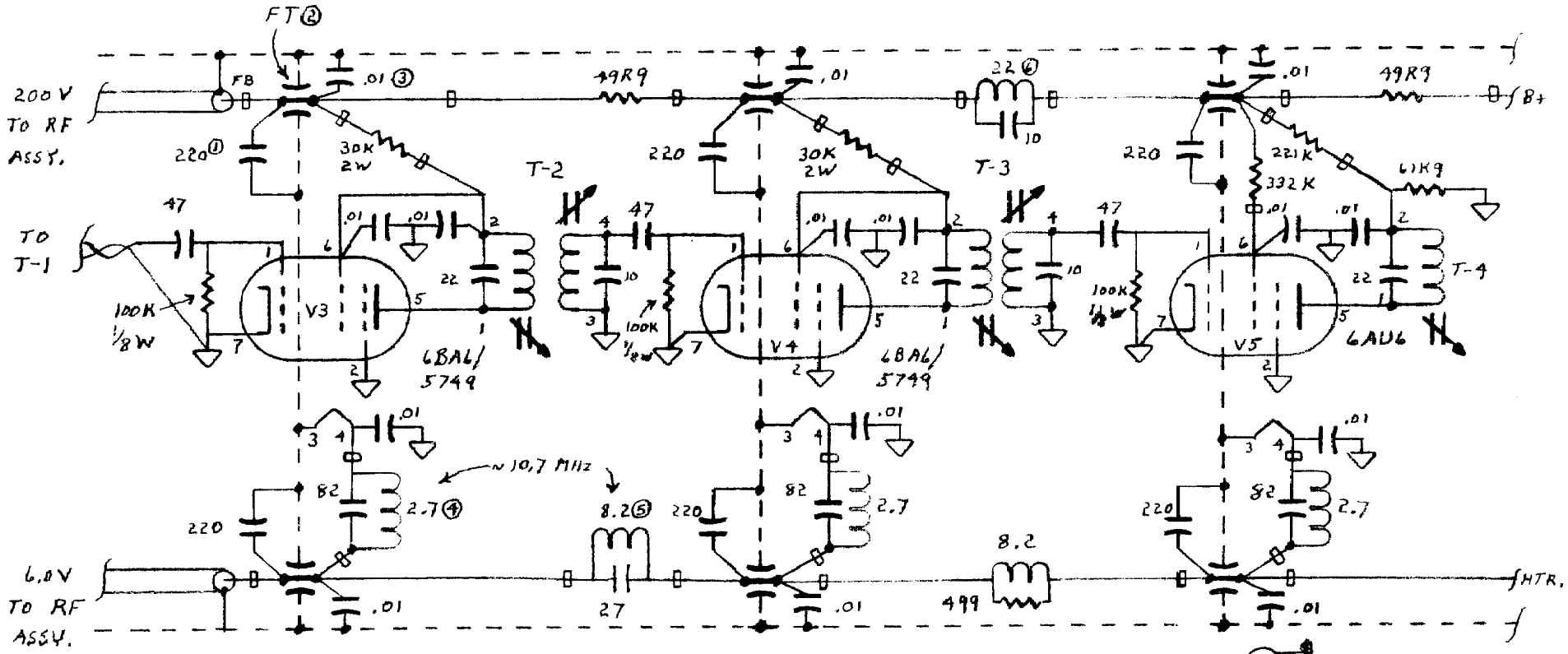
FM-3 RF MOD.



NOTES: ① SELF RESONATE @ 10.7 MHz (≈ 0.3" LEADS)

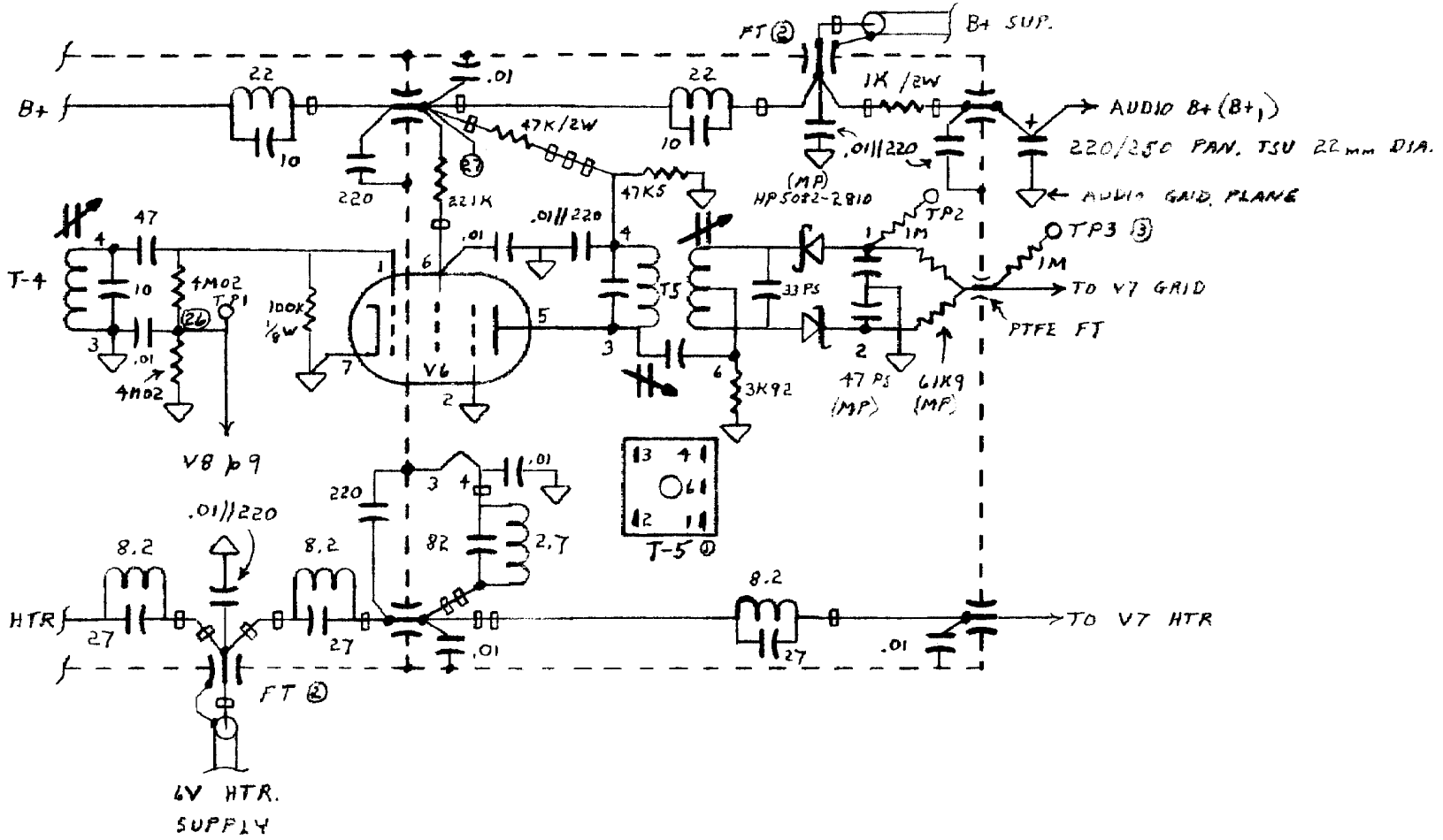
② FARADAY SHIELDED TURN OVER LOW IMPEDENCE END OF L1. REMOVE OLD PRIMARY.

③ C1B & C1C VARIABLE TRIMMERS ON C1 NOT SHOWN



NOTES: ① 220 pF DISC CERAMICS - SERIES RESONATE TO 10.7 MHz, EACH LEAD 0.2"
② FEED THRU >470 pF CERAMIC, BUTTON MICA OR PI SECTION FILT (SPEC. CONT. 1214-001/NEWARK 19F687)
③ ALL .01's - DISC CERAMICS - SERIES RESONATE TO 10.7 MHz, EACH LEAD ≈ 0.2"
④ DIGI. DN2530
⑤ DIGI. DN7412
⑥ DIGI. DN2552
⑦ FERRITE BEADS - DIGI. P9822 TYPICAL - $8/100
⑧ GENERAL: ALL PARTS MOUNTED BELOW CHASSIS / TRASH JUNK PARTS ON TOP
.01 DISC CAPS - Y5P DIELECTRIC, >300 V / ALL OTHER CAPS NPO/COG - NOTE VOLT REG.
FOR THE "CHANGE-EVERY-CAP-TO-FILM" CROWD - KMAGYOYO -

FM-3 MOD IF STAGES 1→3



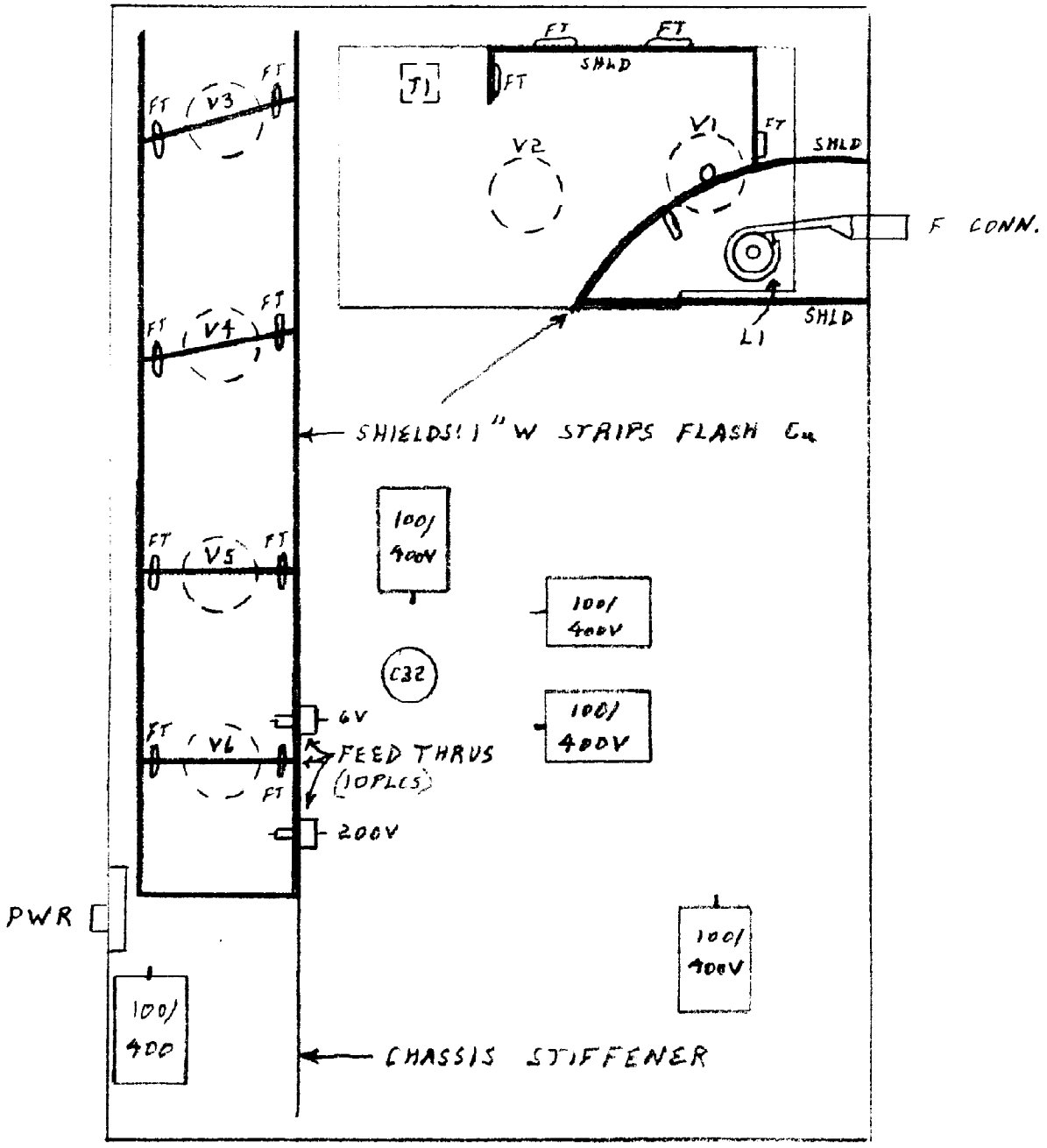
NOTES: ① XFRMR T-5 – REPLACE DIODES ⓦ H-P 5082-2810 & 33 μF CERAMIC ⓦ 33 μF POLYSTYRENE. DRILL CLEARANCE HOLES AT TERM. 1, 2, 3 & 6. INSULATE TERMS. ⓦ PTFE & WIRE PARTS DIRECT. SIGNAL LEADS/TERMS SHOULD NOT TOUCH PHENOLIC. MATCH ALL APPL. PARTS. MODIFY CAN GROUNDING LIKE IF CANS.

② POWER INPUT FEED-THRUS PLACED IN OLD HOLES (FOR MULTIPLE-LEADS) IN CHASSIS STIFFENER. LEADS TO V8 RUN ABOVE CHASSIS. NO EXTRANEOUS LEADS IN DISCRIMINATOR CAVITY.

③ TEST POINTS BROUGHT OUT TO THE CHASSIS TOP SO ALIGNMENT POSSIBLE ⓦ BOTTOM COVER INPLACE.

FM-3 MOD LAST IF/DISC.

FM-3 GEN. LAYOUT



Welborne Labs

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

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.

We are closing out the KR Enterprise VV Valves to make room for the New KR2A3, KR300B and KR300BXLS tubes plus a few new tubes to be unveiled at Winter CES. All sale tubes below have the KR 1 year warranty from date of purchase. Visit my website for KR pictures, specs and curves. **http:// www.welbornelabs.com**

VV300B...the following are all electrically the same tube, just different glass shapes and color. The cylinder tubes are just that...they have a cylindrical shape with a flat top.

VV300B	regular transparent glass	$200 per pair	***Bottleheads: Buy 2 pair... take a 5% discount.***
VV300BL	regular blue glass	$200 per pair	
VV300BC	blue cylinder	$200 per pair	
VV302BL	regular blue glass	$200 per pair	***Buy 3 pair... take a 10% discount.***
VV302BC	blue cylinder	$200 per pair	

VV32B...these VV32Bs are all electrically the same tube except for glass color and shape.

VV32B	regular transparent glass	all gone	
VV32BC	transparent cylinder	$250 per pair	***Hurry, quantities are limited. All sales are final.***
VV32BL	regular blue glass	$250 per pair	
VV32BC	blue cylinder	$250 per pair	

VV52B...these VV52Bs are all electrically the same tube except for glass color.

VV52B	regular transparent glass	$250 per pair
VV52BL	blue glass	$250 per pair

Welborne Labs
P.O. Box 260198 Littleton, CO 80126 USA
PH: 303.470.6585 Fax: 303.791.5783 E-Mail: wlabs@ix.netcom.com

Brainiac s Heavy Metal

...an occasional review of some nifty chunk of iron (usually cheap!)

Today s Topic:
the Allied Ally interstage transformer

OK, so I couldn t think of a clever name for this one! If you have a better name, let me know!

This unit is available for 15 from Allied Radio, and is one of the small class of cheap interstage units available. There are several in the 10 to 20 range, made for old radios usually. Nothing fancy, but their small size makes for low leakage inductance even without interleaving and they can sometimes be used with decent results. They are usually designed for SE drive of push-pull output tubes, so they are not optimum for single-ended output. In my experience these transformers are often very inaccurate in their specifications they should be measured before a circuit is designed around them. This one is attractive because it operates at a relatively high impedance level. It can comfortably use a 6J5 or 6SN7 or 12AU7 tube in single ended drive at reasonable current.

This one is in a U-channel frame, with a lamination stack of 1.875 by 1.5 by 0.625 inch and mounting holes 2 3/8 inches apart. It weighs 8 oz. on my kitchen scale.

Low frequency data:

Turns ratio:	1:1CT specified for 10k:10kCT impedance
Primary:	1240 ohm DC
Secondary:	798+731 ohm DC
DC current:	Inductance with 12v/ 60Hz excitation is 44H at 0v, falling to 22H at 24mA. I would rate it at 12mA, where inductance is 35H
Peak output:	52.5v + 52.5v at 40 Hz.

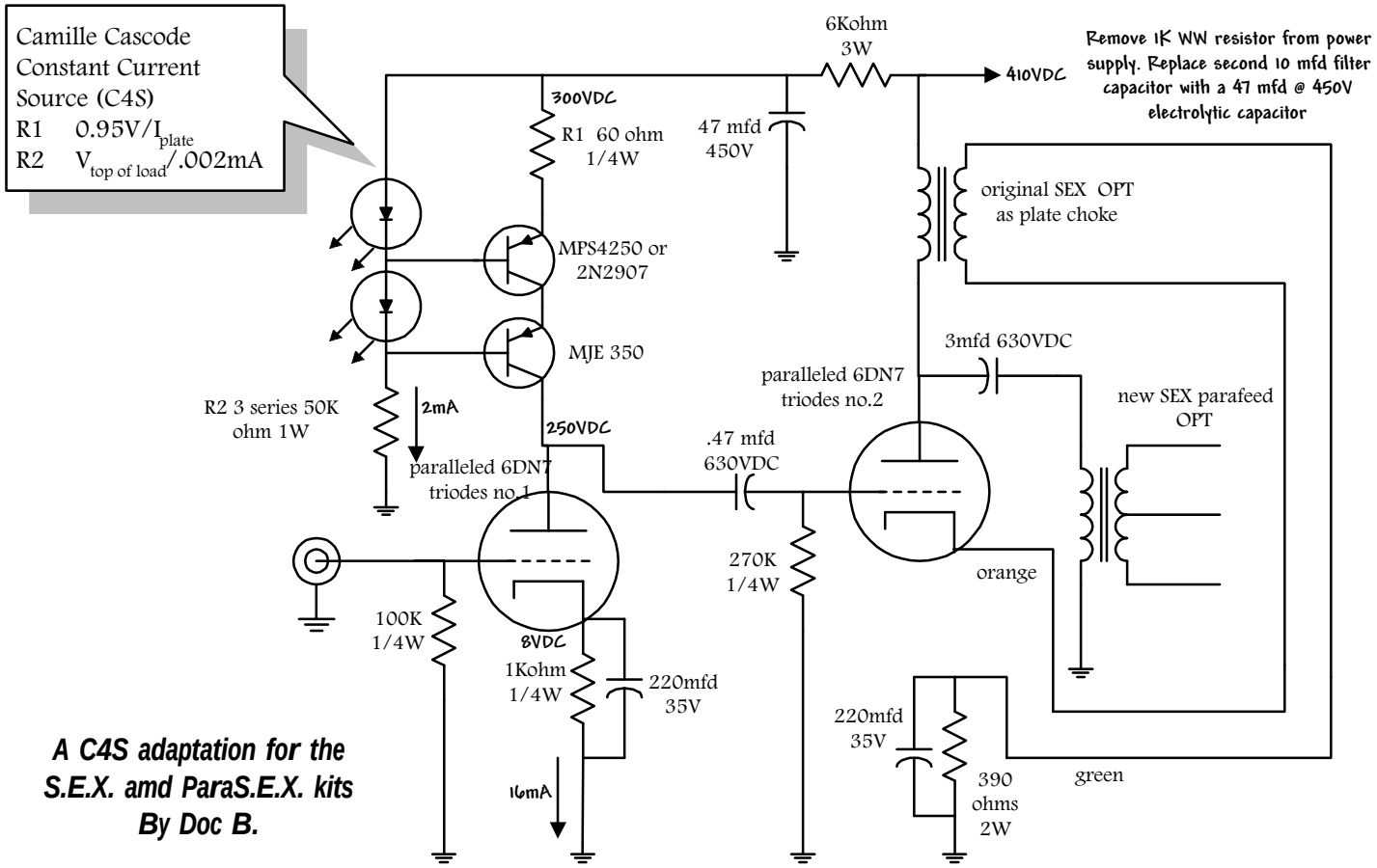
High frequency data (resistances for a decent-looking square ware at 5kHz)

push-pull:	Source impedance 8k plus a load impedance of 12k + 12k leaves only a tiny residual ringing at around 250kHz - not bad at all! Both sides are -1dB at 10kHz they are down 3dB at 25 and 28kHz. Bass extends to -1dB at 45 Hz, -3dB at 20 Hz with small signals (7 volts rms)
single-ended	Seems to work best with 8k source and a 15k load end-to-end. It s -1dB from 45Hz to 11kHz -3dB at 20Hz and 20kHz. Not as good as push-pull, but not terrible either.

This is pretty decent performance, considering the price. It could, just barely, drive a pair of 2A3 s in push-pull. The fact that it could do so with a 56 as driver is attractive, though another gain stage would be needed for any reasonable sensitivity. The relatively high impedance and decent current handling means the driver can operate at reasonable voltages, as much as 300-400v, something other interstage transformers have a hard time with.

Paul Joppa

ActiveS.E.X.



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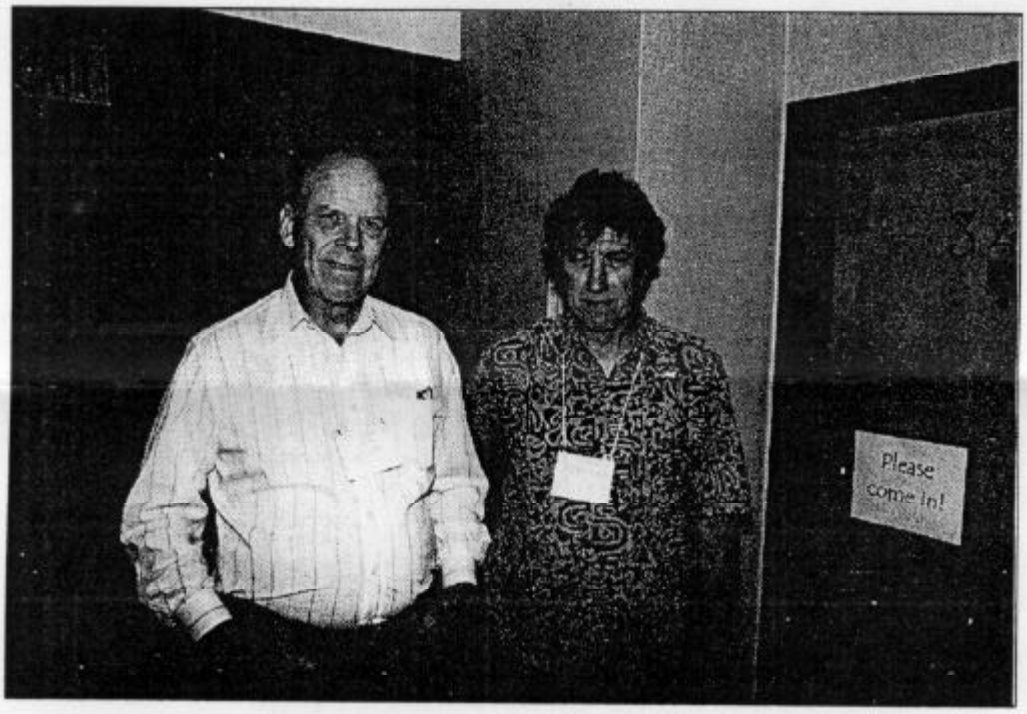
December 3

Dan,

Ever on the lookout for lies and perversion of the truth, I found a photo purporting to be John Camille and myself on page 102 of the most recent Positive Feedback (Vol. 7, No. 6).

Looking through my files, I find that this is actually from a June edition of the Laredo (TX) Flash. Robinson isn't going to get away with this. I enclose a slightly enlarged copy, including the original caption.

Best,



Laredo - Famed DEA agent Juan "Bud" Camillo with notorious drug smuggler Dong Raber shortly after the latter's capture. Camillo deduced from the suspect's mien and attitude that he had ingested up to five kilos of evidence to avoid.

Fi n Art

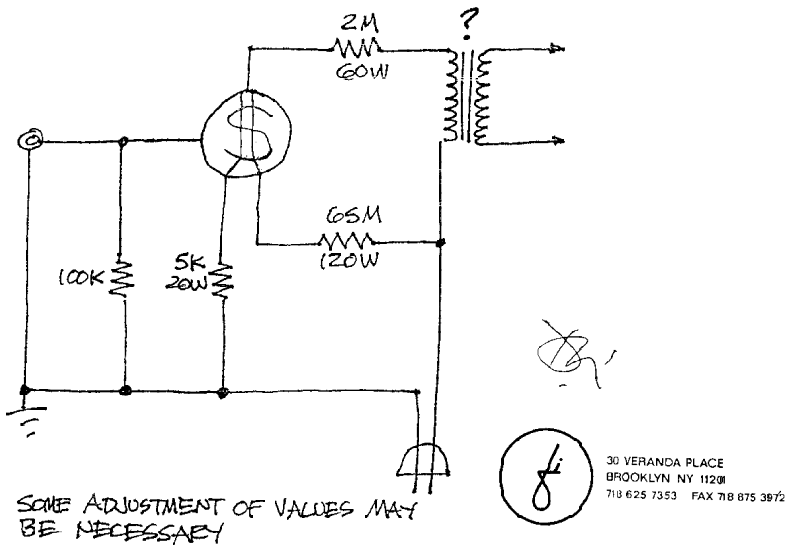
by Jeremy Epstein

Don Garber, the man behind the Fi amplifier company, has an enviable life. Ensconced in a commodious hundred-and-fifty-year-old Brooklyn carriage house, Don paints abstract paintings and builds a unique line of bottle-driven audio equipment. He has the good fortune to be supervised by Max, his shaggy big dog, and inspired by Ikuyo, his muse, who was responsible for my visit.

My wife was talking to Ikuyo, Don s wife, at a party a few months ago. She came and told me, Ikie s husband builds tube audio gear like that stuff you re into. I explained to Don that I was a neophyte bottlehead, and he was very kind. Later, I checked up on Fi and quickly learned that my neighbor was responsible for some of the most interesting wattage-challenged gear around, and that he had been a pioneer in the emergence of triodemania here in the US. So I imposed on his hospitality and invited myself over to see what a real professional amp builder looks like.

Piled neatly in the Fi production space were dozens of chassis plates, which Don had just finished drilling for the next batch of amps. Trannies and tubes were stacked in neat little rows and aluminum sawdust was everywhere. While Don chooses his parts with deliberate care, according to quality, price, and their synergy with the circuit application, he doesn t seem to me to be using anything wildly esoteric or mysterious. Since he builds in small quantities, he gets his parts in reasonably-sized batches : there were no tell-tale crates revealing bargain bulk sourcing. I buy my parts from some of the same places Don does. Most of the tubes he uses are current production. About the only evidence of a tweaky mentality I saw was the silver wire used inside the amps, hardly voodoo. And Don admits, I m no great audio designer, and I don t want to contend that I am. I guess I ve looked at a lot of things, tried a lot of things. My approach is more empirical than anything else. What he shoots for is simplicity, value, precise workmanship and a clean look. He doesn t much like talking about audio, and hype is notDon s style. It s an awful lot easier to get him talking about music.

I ve been struck by audiophiles in general, (I tend to think my customers are a little better than most, or is that just my own ego in there?) the music they listen to - you ll try to get past my snobbishness - is such trash! But most of them, it s just to demonstrate their systems. And I find that this tends to be less true among people that build their own stuff. You would think it might be the other way around but it s not. Don and his wife regularly calibrate their ears by attending chamber concerts at Bargemusic, a floating concert space moored under the Brooklyn Bridge. A window onto the lower Manhattan skyline forms a spectacular backdrop for the world-class musicians who perform there. Perhaps it s his experience dealing with the audio salon crowd (Fi was started partly to feed product into a retail store of the same name Don ran a while back) but Don Garber is no fussbudget. When I arrived at his shop/soundroom he methodically set up his wonderful 2A3 monoblocks to drive Exemplar horns with zip cord *(Yo, Don, Smoothplate's gonna crap his pants when he reads this -B.)*, no-name interconnects, and a little beer. Carefully, he tuned the room by moving a pile of cardboard boxes out from in front of the right speaker, and powerline conditioning was taken care of by a 50 orange extension cord and some cheater plugs. Together we listened to some mutual favorites, like the new Dylan live set and Lucinda Williams long-awaited new album, and I turned him on to the terrific guitar Goldberg Variations by Kurt Rodarmer. We talked about a lot of things : Brooklyn real estate, family, slide guitar, and even the business of audio. Neither one of us was unduly bothered by the cheap interconnects, let s just say, and my cassette of our interview has the same relaxed, open, effortless sound as the original playback. At one point, Don commented, I can get into a discussion about a specific thing or a specific problem or approach to something and do that, but the audio bullshit session just kind of drives me up a wall. So I shut up and listened a bit closer. I heard an awful lot of music coming out of Don s system, both with the 300B X³ and the monoblock 2A3 amps : we listened to different styles of music on each but I preferred the 2A3 s and Don concurred. He said, The 2A3 amps are the better amp, but you have to compare them on a level playing field. These speakers are efficient enough that it truly is a fair comparison, but if you get, say, a pair of Spendors, and you play the 300B s with them, they do this - and he proceeded to caricature the stance of a pumped-up muscle guy.



Don has enjoyed some attention with his recent new product, a stereo 2A3 amplifier named the X. I wanted to build the cheapest good 2A3 amp that I could. There were a lot of people that wanted to buy one and couldn t afford it. He has done that and more. The X features a chassis in the shape of an extruded letter x standing on its end. It looks a little like a tank trap with tubes and transformers peeking out of various planes. I doubt I am the first to predict that the Fi X will someday be in the permanent design collection of the Museum of Modern Art. Its construction literally turns amp design on its ear. The X arrangement is more than just startlingly cool, though : it provides physical isolation between power supply and audio circuitry, permits excellent ventilation, and cuts the audio signal path shorter than a New York minute. He has built on the novel X with two new products : the Y line stage and the X³, a 300B stereo power amp.

I asked Don how he thought up the X chassis concept, and he said, I d been thinking of doing a cheap version of the 2A3 amp for a long time and I knew partswise what to do, how to keep the price way down. But I didn t want to put it on a little Bud-box chassis, because then it would look just like every other cheap little amp. I tried this idea and that idea, with the idea of keeping the power supply and the amp seperate. I didn t come up with anything that was any good at all. I was riding the subway one day, when I was just . . . there it was! He smiles and his fingers make a little x as the words trail off. I quickly sketched it on newspaper, came home, figured it out, and everything just fell into place. It worked perfectly. I m not sure how it happened, it was just one of those inspirations that happens. It looked like his amplifier brainstorm went on to inspire a painting : hanging on the wall was a bichromatic canvas with corner-to-corner diagonal elements.

He was clearly proud of another creation : an elegant WE 421Astereo amp sporting only a dual triode driver, the dual triode power tube, and a rectifier nestled amidst big iron. He took it down off a shelf to show me. This was the first one to use the multiple levels of chassis plates, the signature style of the earlier Fi amps. He showed me how the design inherently shields and physically isolates the audio path from the power supply. Naturally, it also looks very stylish. Here is a man whose products embody modern industrial design, who paints in a clean, abstract style, and yet spent about a half hour lovingly displaying some of his antique tubes, including the bizzarre 316A, which looks like a tiny weathervane inside the brain of Rosie, the Jetsons robot maid. Like his 3-tube stereo amp, Don Garber may look simple but he works on many levels.

While Don has been refining his taste in circuitry for decades now, he allows room for improvement : Somebody said I got to the point where I kept taking things out until it stopped working. And then put that part back in, and that was it. Not quite, but almost. From what I hear, simpler is usually better. Now you could make that into a rule, and go and carve it into a beam up over your shop. But then tomorrow you might find out that you re wrong, so I don t like to get into making rules. As soon as you make something into a rule, you close doors. Doing that may make your life simpler, but . . . Don s affection for simplicity is reflected in his preference for direct-coupled circuits. When we were discussing some of the tradeoffs in designing the inexpensive X, Don pointed out that a direct-coupled

design is more forgiving of LF limitations in the output transformer : there is no rolloff from the coupling cap to exacerbate any bottom-end phase shift in the transformer.

While the original (2A3) X is direct-coupled, he was clearly disappointed that he could not direct-couple the new 300B version and still make it work in the X chassis. The more complicated power supply also would have driven the price of the X^3 too high to fit in with the conception of the X as an affordable product. I wouldn t be surprised if an all-direct-coupled 300B amp comes out of Fi in the near future : Don has a pretty clear idea in mind of how he wants one built.

Also in his plans : a phono stage for the Y preamp, and experimenting with the sound of the beefy KR 2A3 when run at a higher dissipation. Don s curious, though he s not sure a move up to six watts will be worthwhile. The remarkably musical 2A3 sound may or may not show up using that operating point, he suspects, and also he s not sure a six-watt amplifier compliments many more speakers than a three-watt amp does. Garber is the easternmost member of the Audio Dream Team, in charge of chassis and layout for the upcoming hush-hush project soon to come out of Area 51 in the Mojave desert. Parallel-fed, active-loaded, transformer-coupled, this X-wing fighter is going to pack a fair amount of iron on whatever chassis Don comes up with. I joked with him about a Kustom Kandy Kolor for such a hot rod, and he scowled. (Don scowls a lot.) I like things to look like what they are. If it s metal, it should look like metal. Later on, he pointed out a small cosmetic flaw in a transformer prototype he had rejected for other reasons. Clearly, this is a picky guy with strong opinions about how his equipment looks as well as how it sounds. I asked Don if he thought the work he puts into his gear satisfies the side of his soul that is also a fine artist. It s nothing like painting, that s a totally different thing. I ve read people talking about, building amps and so forth is an art of its own. No. No, it s craft. He pointed towards the speaker, from which played a legendary live recording by another cranky master. What s coming out of that, that is the art.

I hope Don Garber gets the satisfaction someday of seeing his paintings hanging in a museum. But painting is a crowded, competitive field, and many who excel are never recognized. He may have to settle for seeing his X amp on a pedestal - it s a shoo-in.

Re : the schematic. Don said, "I wish I had priced the X at $892.00 instead of $895.00." I asked why. "So it would be exactly 1/100th of the price of the Ongaku. Whenever you hear, 'cost-no-object,' cost IS the object".

X

da basics

Improving our soldering skills

by Doc B.

Here s a little reparte I had with a novice Foreplay customer a while back after helping him get his Foreplay up and running by resoldering all the joints:

I practiced soldering with my sca-35 and replaced some its dried up wires and got that working. That was my first solder experience. I guess I will solder next time by heating up the end device first, say a lead or terminal connection then try to get the solder on top of the wire and then apply tip to the solder.

The trick is to get the tip of the iron in such a position that it heats both the wire and the terminal it is being attached to at the same time. This is critical, otherwise the solder may only adhere to the one surface that s hottest. You should get both the wire and terminal hot enough that you will melt and flow the solder when it is applied to the joint itself, not the tip of the iron.

If this creates a non shiny solder then should I reheat the connection until it hot again and see if that settles it?

In general yes, although some of the newer types of solder like the 97% tin /3% copper lead free solder I use flashes to a dull finish when cool, even on a perfect joint. The thing to look for is an even coating of solder over both the wire and the terminal, and that the solder has flowed enough to form a more or less concave fillet instead of a convex blob or ball at the joint. When reheating a joint it is a good practice to add just a bit more solder to the joint, which helps stem the inevitable pull of gravity drawing the remelted original solder down away from the joint. If a joint is already gobbed up with a lot of solder, use solder wick or a desoldering bulb to remove the excess before resoldering the joint.

I think I got the basic idea behind it (not the dexterity quite yet) but would appreciate any more soldering tips. Since I want to jump to a 2a3 amp next I dont want to keep on making those errors.

Part of the trick is to attach all the wires securely by wrapping them around the terminal before you solder the joint. This frees you from trying to hold the wire in the terminal while soldering, leaving one hand free to hold the iron, and one hand free to apply the solder. Holding a wire in place while soldering is not steady enough, the joint will inevitably crystallize while cooling due to tiny movements in the wire. Make sure the solder gets hot enough to freely flow over and through the joint. The whole joint, all around the terminal, should be penetrated and evenly coated with solder.

Using a hot enough iron is important too. Most of the hotshit solderers I know have an assortment of irons. Always included in this assortment is a big ugly 45W-55W iron with a big chisel tip. If their fancy little temperature controlled model doesn t heat a thick joint enough, like say in the case of soldering speaker wire to terminal posts, they bring out the big mutha and the job is a done deal.

What do those stripes on the resistors mean?

We get a certain number of calls complaining that we don t hand label each 1/4 watt resistor in our kits. Newsflash, folks. They are already labeled. It s just a matter of knowing what those little stripes mean.

The basic layout used involves four or five stripes. On older style precision resistors there are usually four stripes, on newer metal films there are often five to accomodate the hair splitting values available in the 1% types.On either style of resistor all but the last stripe denote number values according to the following plan:

black	0
brown	1
red	2
orange	3
yellow	4
green	5
blue	6
purple	7
grey	8
white	9

On the four stripe variety, the first two numbers denote ordered values. On five stripers, the first three stripes denote ordered values. For example if the first two stripes on a four striper are red, purple, we are looking at 27.

The next (second to last) stripe on either value denotes a power of ten multiplier. For example, abrown (value 1) stripe denotes that you should multiply the first two (or three) stripes by the factor 10^1, or ten. So a four stripe resistor with the first three colors of colors red, purple, brown would translate to 27 X 10^1 270 ohms. Red, purple, yellow (value 4) would be 27 x 10^4 or 270,000 (a.k.a. 270K) ohms, etc.

To denote the 270 ohm value on a five striper, the first four stripes would read, red, purple, black, black, which translates to the first three stripes denoting the number 270, and the fourth stripe denoting a multiplication factor of 10^0, which is of course, one.

What about the last stripe? It denotes the tolerance, or accepted plus and minus range of variance of the resistor s value from that stated by the stripes. Mostly these days we see gold, which denotes a 5% tolerance red, which denotes a 2% tolerance and brown, which denotes 1% tolerance. There are other codes not so often seen anymore, unless you are fooling with old carbon composition resistors - silver is 10% tolerance, no stripe is 20% tolerance, and even more obscure, yellow denotes 4% tolerance and orange denotes 3% tolerance.

So, you are now thoroughly confused and your middle aged eyes can barely make out the stripe colors anyway?
That s why God invented the volt-ohm meter, homes. Just measure the damned things with the meter set on the ohms scale and forget this.

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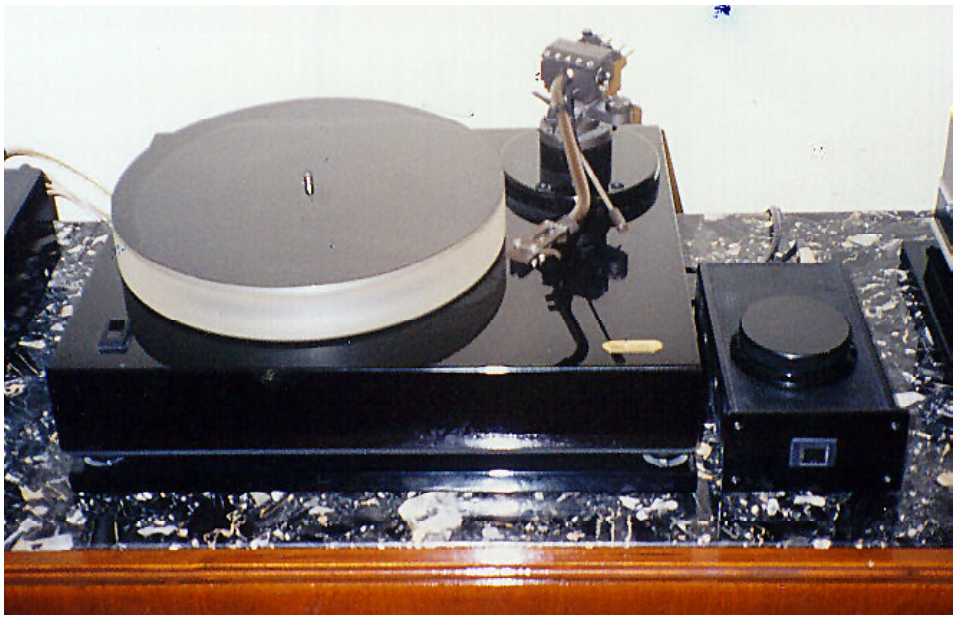
experiments with a turntable - part two

By Rene Bolders



a new platter

After the successes mentioned last issue I began to look at the glass platter a little more critically, and I wondered if I could possibly improve here. At that time acrylic platters became very popular in Germany and elsewhere, and since acrylic or Perspex is very close to vinyl materialwise, I felt that it could be a good match.

I chose Perspex as a suitable material because it has high density but it is not too hard and is easily machined. I bought a block 14 x14 x3 and started by cutting a rough round disc with a bandsaw. Since I m a machinist/fabricator by trade, it wasn t very difficult for me to turn out a nice platter on the lathe.

The height is the same as the glass platter since I wanted to do a direct comparison between the glass and Perspex without changing the tonearm height. Well, it was worth the trouble, the acrylic platter produces an overall deeper bass. I feel that the bass and midbass both increased, and the soundstage also seemed to be deeper and more convincing.

I tried the two platters back and forth the following days but the acrylic platter was always the clear winner. Weight-wise I didn t gain or lose anything, important to preserve the bottom bearing load.

speed control

Next I began to look at the platter speed, because I had noticed for some time that it wasn t as constant as I d wished. The little motor is basically a 110 volt motor, 24 pole synchronous type, but it was wired for 230 volts, which means if you look at a stroboscopic disc with a neon light you ll notice that the little dots or stripes do not stand still, but rather they kind of go forward and backward all the time as if they were vibrating

The root problem is that the 24 pole synchro motor gives 24 little jerks in one revolution. This is visible with a good stroboscope. Om top of that the overall speed varies quite a lot depending on the time of day because there is not always 50Hz (or 60Hz in the US) coming out of the wall outlet.

I measured and monitored the line voltage and frequency for a couple of days, only to see it fluctuate from 218 volts in daytime to 238 volts at night. the frequency varied from 48 Hz to 53 Hz. This is not a very desirable situation, and in my opinion is audible.

My good friend Bernd (still lives in Berlin) came up with a solution. He designed an external power supply circuit board for 110/220V 50/60Hz operation. All I had to do was build a nice enclosure, install a few plugs and rewire the motor to 110V. See the photo showing the power supply sitting next to the turntable. The round thing on top is a record clamp.

The power supply generates a precise square wave through a high frequency quartz generator and digital divider. Frequncy can be set for an exact 50Hz or 60Hz. The signal then goes through an active filter and gets converted to a pure sine wave.

A nine watt class A amplifier amplifies the sine wave and feeds it straight into the motor. Because the 110V motor was wired to 220V through a voltage divider, I gained some torque as I hooked it back to 110V. This was to my advantage because of the relatively high mass platter. The constant feed of pure 110V 50Hz into the motor independent of mains fluctuations made the motor turn very constant. When I measured the speed with the stroboscope, to my satisfaction the stripes on the disc were nearly standing still. Of course the motor is still a 24 pole synchro motor, but with a clean signal feed it works great.

I would describe the advantage of an external power supply to be better control in the bass region, a broader soundstage, and a cleaner sound overall.

two steps forward, one step back

The next experiment went wrong.
I noticed that on Pierre Lerne turntables the surface of the platter is not straight but concave. The reason for this seems to be that the record has good contact with the surface of the platter. The record clamp or weight forces the record to the surface, so even if a record is slightly warped it will still sit solidly on the platter and not wave in the air.

Some records are concave themselves which results in them siting on the platter either as a little hill or when you turn them around as a frisbee up in the air. I know one should try to avoid buying frisbees, we all like 180 gram audiophile virgon vinyl limited series handpicked and so on. But if you like older stuff like me, jazz from the 50 s and 60 s, and you finally find the one record you were looking for for two years, you can t be picky. You have to find a way to make it work. Thus, following this spirit, I machined the platter slightly concave.

I adjusted the cartridge parallel to the platter s surface to have a good vertical azimuth. First I used a precision ruler to align the cartridge body to the platter and later I checked with a test record (1kHz test tone) and a digital voltmeter for fine tuning.

Now all this works great when you play frisbee s from the 70 s and 80 s, pop music and so on (Dynaflex records work great). But it all starts going wrong when you play LSC s, Blue Notes, and especially 180 gram pressings, because they don t give as easily as you would think. Plus, because of the differences in thickness the vertical azimuth changes all the time, which results in decreasing channel separation as well as lost balance and soundstage width. On top of that, when it gets to an extreme one channel plays louder than the other, there is excessive groove wear on one channel and the antiskating is affected.This is all very theoretical, but I still don t like it. On high quality turntables everything matters and everything is audible.

I fought with these problems for a month or two, but then I lost patience and resigned, which resulted in my machining the platter straight and setting the cartridge back to where it was. A nice vacuum hold down might do the job, but I haven t gotten to this yet.

tonearm cable

As I mentioned earlier, my turntable came with a Grado Signature Tonearm and Grado interconnects. The interconnects proved to be very good, but they are as old as the turntable itself (15-20 years, who knows?). Through time they may have become corroded or something, anyway I told myself this as an excuse to try something new.

I bought van den Hul phono interconnects with a straight DIN-plug and liked them, but only until my friend Bernd suggested trying a Straightwire Microlink cable. I like this cable a lot, in fact I still use it today, it is specially designed for low level analog signals and doesn t cost a fortune. I m lured by some of today s top cables and I shall try to replace the whole cable (including the tonearm, and removing the DIN connection), probably with Kimber Silver, Cardas, or Discovery.

cartridge

The Grado Signature cartridge installed on the tonearm when I bought the turntable had a bent cantilever. My friend Bernd just happened to have a brand new Benz MC-2 and since the price was right, it went straight under the Grado headshell.

The Benz family of cartridges is somewhat of an interesting story. The Benz Company (from Switzerland) is a manufacturer of high quality cartridges. They design and manufacture cartridges under thier own name as well as producing cartridges for other companies, which sometimes leads to confusion. My cartridge is called the MC-2 (Europe), however kit is called the MC-3 in the US, and is identical or very close to the Madrigal Carnegie 2, Taurus DDT, Empire MC1000, van den Hul MC-10, MC-one, MC-two, Empire MC-2000, and has lots of similarities with some Ortofon units. This is not to say a bad word about Benz Co., but rather to take some of the hype out of cartridges. The same goes for Scan-Tech of Japan, who also make a whole range cartridges under different names.

Anyway, my Benz MC-2 worked great for a year or so but then the sound slowly began to degrade. At first I thought I had some bad records, but I began to notice how the strong bass and clear highs were dissappearing, and the soundstage width and depth began to dissappear. After some troubleshooting we tracked the problem down to the cartridge. It became so bad that I had to send the cartridge back to the factory. It turned out to be a suspension related problem. What happened was the little rubber suspension ring had dried out and become hard so that it limited the cantilever free travel. I later heard that this happened to other cartridges too. The factory replaced the rubber ring with one of some other material and all work fine now.

For me this cartridge is a typical MC cartridge - deepbass, laid back midrange and good highs with a lot of detail. I used 2.1 grams tracking force and 24 degrees VTA (rear of cartridge/tonearm slightly down). the factory recommends a tracking force of 1.8 grams, but I didn t like it so much, it was somewhat thin sounding. The channel separation is given as 28dB and it puts out 0.3 mV which means that an excellent phono stage is a must.

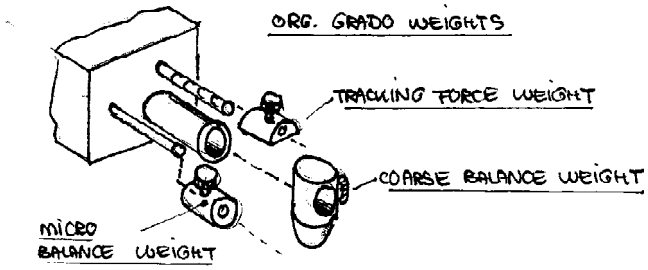
While my cartridge was at the factory I still wanted to play records, so I checked out my friend Bernd s collection to see what he had that I might like. As it happened a Koetsu Black Magic Gold had just arrived from van den Hul where it was serviced and retipped. I purchased it on the spot and it really made me happy, in fact I still use it today. There is something special about Koetsus. I heard a Koetsu Rosewood on Bernd s Goldmund turntable, so I know what I m talking about). The Koetsu organizes the sound and puts everything in the middle where it belongs, but with a wide and deep soundstage. *("Honey" is the term my Aussie buds use to describe the K. sound - I'm in love with my own Koetsu Black as well - B.)*

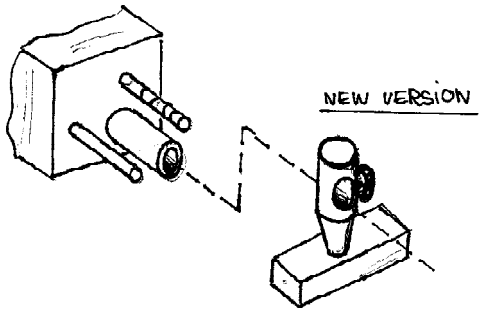
The Koetsu is very sensitive to all parameters. After much trying and experimenting I ended up with a VTA of 25 degrees, tracking force of 2.0 grams, 47Kohm loading and a 100 pF cap. The difference between 1.8 grm and 2.0 gram tracking is very audible. It s fun to experiment with this Koetsu because when everything is right it really sings.

tonearm

All this experimenting led to modification of the Grado tonearm.

It s Grado s approach to not use only gravity or only spring force to adjust tracking force, but rather both. For 1-1/2 grams of tracking force, the setup uses 1 gram of gravitational load and 1/2 gram of spring load. With a combination of a built-in spring and several weights this is a relatively easy adjustment to achieve on a Grado tonearm. Once the tonarm is set up it is a great tracker, but some recent developments made me curious.





DRAWING # 3 : ORG. GRADO WEIGHTS AND NEW VERSION.

Some friends in the German audio community believe that a tonearm should have no damping at all, but rather should move as freely as possible in order to get that last little bit of air. One friend uses a Grado tonearm in which he took the damping completely out - no spring load, just the counterweight load, and he reports good results.

The Grado tonearm has one big counterweight and two small ones, so called micro-weights, for setting the gravity to spring force ratio. This brought up an idea - what if I take out the spring load, construct one weight which is lower, actually below the cartridge, and take the little weights off the tonearm? The idea was that by constructing a new weight I could lower the center of the counterweight compared to the turnaxis (center of gravity) and move the weight closer to the vertical axis. This would give a more stable tonearm with respect to up and down movement (faster standstill) so it would play slightly warped records more easily. See drawing three for inspiration.

I constructed a new counterweight which is solid aluminumand steel by measuring the original weights and trying to get as close as possible. Of course the first attempt ended up way too heavy, so I had to machine the sides a little more until it worked. Adjusting the tracking force is a little difficult now - if you move the weight a little too far you re immediately off 10-15 grams! I didn t change anything on the tonearm, so I could always go back to the factory setup

But it was worth the trouble. The sound is very airy now. Remember the tracking force is still 2.0 grams, but the damping, other than the friction in the bearings, is gone. I like it better the way it is now, but some reader will disagree and use a spoon wading through a basin of silicone oil!

Shortly after I completed the experiment with the counterweight I spotted an article about a Roksan tonearm upgrade called the Tabriz Tonearm with 2i counterweight. On the Roksan Artemiz counterweight this idea has been taken to the limit, the weight rests only on a spike so it can swing freely without moving forward or backward and altering the tracking force. This works great and I m a little surprised not to see more manufacturers picking up the idea. It s probably a matter of taste.

Right now I use all the above mods with great satisfaction. I use the Welborne Labs Phono-1 kit in connection with a German made pre-preamp. I have about 63 dB gain (Phono-1, 36dB, pre-pre, 27 dB) which is a lot, but then again quite a lot of cartridges put out something in the neighborhood of 0.3 mV, so this is about what is needed.

The loading is 47kohms. I tried 100K, 30K, 10K, and even no loading in the past, but I go back to 47Kohms every time. The capacitive loading is 100 pF. My system consists of a switching unit with stepped attenuator, two Welborne Laurel monoblocks with Cetron 300Bs and a full range Edgarhorn system (see October 97 VALVE). I found it unecesssary to use a preamp because all components put out more than 2 volts, enough to drive the laurels/Edgarhorns to disco level. However, I installed a buffer to compensate for the 20 ft. Kimber interconnects.

Maybe Ron Welborne was right when he mentioned in his catalog This is the last phono amp you will ever need . Maybe that and a pair of triode amps and good horns is all we really need.

Electronic Tonalities *MagneQuest*

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Parallel Feed Output Transformers

EXO-36 2.5K:8 ohms, 3 watts max, permalloy core, solid brass channel frame. 2A3, 6A3, 6B4 - 270 pr.

EXO-35 2.5K:16 ohms version of above - 270 pr.

EXO-45 5K:8 ohms, 2 watts max, permalloy core, solid brass channel frame. 45, 71A, 417A/5842, 6CK4, 6DN7 - 270 pr.

EXO-46 5K:16 ohms version of above - 270 pr.

TFA-2004 3K:16,8,4 ohms, 15 watts max, black end bells, M4 core, 300B, VV32, VV52 - 350 pr.

TFA-2004 Pinstripe (M6 with Permalloy pinstripes), polished solid brass brass bell ends, 300B , VV32, VV52 - 500 pr.

TFA-2004 all Permalloy core, 12 watts max, polished solid brass bell ends, 300B, VV32 - 600 pr.

NEW - EXO-50 5K:16,8,4 ohms, 20 watts max, M6 with Permalloy pinstripes , solid brass bell ends, 300B, 845, SV811A - 550 pr.

Parallel Feed Linestage Transformers

B7 15K:500 ohmsCT, parallel feed line stage transformer, permalloy core, brass channel frame, 56,76,6J5, 6SN7,5965,5670, 12AV7 - 198 pr.

B7 5K: 500 ohmsCT, as above, 417A./5842, 437A/3A-167M, 5687 - 198 pr.

Parallel Feed Interstage Transformer

RIT-5 5K:5K (1:1), M6, channel frame - 250 pr.
RIT-5 as above, but with bell ends - 300 pr.
add 100 per pair for Permalloy core

Parallel Feed Plate Loading Chokes

BCP-16 1mA, 425H, 4400oms DCR , channel frame - 80 pr.

BCP-14 10mA, 100H, 2075 ohms DCR, channel frame, - 90 pr.

EXO-01 20 mA, 100H, 985 ohms DCR, brass channel frame - 110 pr.

NEW EXO-99 dual bobbin, configure for10 mA 600H or 20mA 150H, 1129 ohms DCR, brass channel frame - 198 pr.

BCP-15 50mA, 40H, 550 ohms DCR, channel frame - 90 pr.

EXO-03 60 mA, 30H, 344 ohms DCR, brass channel frame - 130 pr.

EXO-04 60 mA, 50H, 317 ohms DCR, black bell ends - 198 pr.

B.A.C. 80 mA, 50H, black bell ends, - 298 pr.

Airgapped Single Ended Output Transformers

TFA-204 3K:16,8,4 ohms, 8 watts, 60 mA - 198 pr.

DS-025 2.5K:16,8,4 ohms, 20 watts, 60 mA - 298 pr.

DS- 050 5K:16,8,4, ohms, 20 watts, 40 mA - 350 pr.

RS-330 3K:16,8,4, ohms, 30 watts, 80 mA, - 500 pr.

RS-500 5K:16,8,4 ohms, 40 watts, 80 mA, - 600 pr.

RS-520 2.5K:16,8,4 ohms, 50 watts, 120 mA - 700 pr.

FS-100 10K:16, 8, 4 ohms, 40 watts, 80mA - regular 850 pr. - **SPECIAL SALE, 450 pair!**

Push Pull Output Transformers

MQ-420-CL 6600CT:16,8 ohms 30 watts - regular 298 pr. - **SPECIAL, 238 pair!**

MQ-431 4300CT: 16,8 ohms 60 watts - regular 378 pr. - **SPECIAL, 298 pair!**

MQ-451-CL 2200CT:16,8,4, ohms, 120 watts - regular 458 pr. - **SPECIAL, 398 pair!**

MQ-470-CL 4300CT:16,8,4 ohms, 35 watts - regular 298 pr. - **SPECIAL 238 pair!**

Peerless 20-20 series model S-271-A, configure as 5000CT:16,8,4,1 ohms, 200 mA, 80 watts or 1250CT:16,8,4,1, ohms, 400 mA, 80 watts - 1200 pr.

Peerless 20-20 series S-275-A, configure as 4000CT: 16,8,4,2 or 8000: 32,.16,8,4 or 12,000:48,24,12,6 ohms, 120 mA, 80 watts - 1200 pr.

Power Transformers

PGP 8.1 120V primary, secondaries 350-0-350 75 mA, 6.3V 2A, 2X 2.5V 1.25A, horizontal (drop through) mount, solder terminals - 165 pr.

5504 universal primary, secondaries 350-0-350 100 mA, 5V 3A, 6.3V .5A, 2X 2.5V 1.25A, black bell ends - 350 pr.

Filter Chokes

BCM-19 10H, 200 mA, 109 ohms DCR - 150 pr.

NEW B.F.F.C. 10H, 200 mA, **18 ohms DCR!!!!!!!!** - 298 pr.

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360-697-1936
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