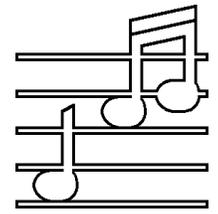


# AUDIO BASICS



The Complete 1984 Back Issue Set.

## VOLUME THREE NUMBER TWO FEBRUARY, 1984

[1990 Note: There is not a January, 1984 issue herein because that issue was the conclusion of the now very obsolete original Super Pas rebuild plan. We do not want that plan set perpetuated because it had recommendations that are in conflict with what our Super Pas Three rebuild kit contains now. If you want to rebuild a Dyna Pas, see our current catalog for the Super Pas Three rebuild kit, new boards and all].

We will start this month with a brief rundown on the Winter Consumer Electronics Show, held in early January in Las Vegas, Nevada. About the best part of the show was getting there and back. We hit the January "Indian Summer" and took the opportunity to exercise the Quattro. With blue skies and warm weather all the way, we didn't even bother with the southern route, and went straight through the Colorado mountains both ways. "Flying" along in the Audi sure makes one feel sorry for all those factory reps cramped up in airliners, and with all the mobile motels frozen in for the season, we actually got to see the mountains, rather than the back ends of thousands of 20 mph and 2 mpg Winnebagos.

The show was, unfortunately, a "time warp," especially the hi-end exhibits. Same old tired claims, same old unsubstantiated arm waving, same old rooms full of loudspeaker boxes that come and go with the seasons, and most annoying, the same old harsh, bright, and aggravating sound. We heard acceptable, musical sound only in a few exhibits, such as:

Acoustat, which showed their new "1+1" series electrostatic speakers which seem to be their best yet in their ability to "vanish" leaving only the music. They are available either as full range units, or for about the same \$1300 price, with a "sub-woofer" and built in crossover. Each version sounds "different" but under the context of show conditions, I was unable to judge which, if either, was "better." Both were pleasing. One "little" problem – if you do not have at least 9 feet ceilings you cannot use them unless you take an axe to your room (or the speakers) - they are tall!

Magneplanar, which showed the new MGIII, using their new ribbon tweeter. This is easily the most lucid and dynamic Magneplanar yet and is probably a good alternative to the bi-polar electrostatics and probably a much easier load for most conventional amplifiers (remember, most electrostatics are about the equivalent of tying a 10  $\mu$ F capacitor across your output terminals – a load that causes great distress to many (not ours) amplifiers).

B&W had a huge display with essentially, a complete new line of loudspeakers from top to bottom. I had one very pleasant surprise. The B&W 110 and 220 models at the show sounded very nice, with none of the harshness or colorations we heard in the early production samples we reported on here. I inquired of the engineer at the show and learned a significant tweeter improvement had been made somewhere around serial number 12,000. In fact, B&W has gone to a new and improved polyamide tweeter throughout the line which is more linear, controlled, and extended than the original TS26 tweeter, which was a hard number to beat. We ordered several of the new models and can report that in our own studio, they are winners and are worthwhile improvements to an already Very musical line of loudspeakers (my overall favorites).

SPICA was displaying their new TC-50 small loudspeakers along with a unbelievably favorable review from *International Audio Review* (state of the art?). We ordered a set, got them in late last week, sent them back a day later. Although they are a pretty decent little speaker with good imaging characteristics, we didn't consider them to be unusual, and bass response was nil – as expected with the very small box volume and small woofer. Overall, they were no match for the B&W DM110 and at \$300/pair for the DM110 as compared with \$440 a pair for the Spica TC-50, the overall value was no comparison in favor of the DM110. The Spica is, of course, one of several lower cost speakers you should listen to if you are in the market for units in this price – size range (along with competition from KEF, B&W, Fried, ADS, Braun, Boston Acoustics, EPI, and a few more). There is not such a thing as a perfect low priced

speaker (or high priced speaker) and you may not hear it with the same sense of priorities as we do.

We were impressed with a \$200/pair set of Mission 70 MKII loudspeakers at the show (excellent image, stage, and balance at their display) and ordered a set on the spot. Today, as I write this, UPS has informed me they will be on their truck for me this afternoon. Thus, look later in this issue for an "in-house" evaluation as we will evaluate them as soon as the UPS man shows up.

At the Perreux exhibit, I did get a look at the amplifier driver circuit card and it gave me a bit of a problem as I could not find any driver transistors. I pointed this out to them and was informed that a tiny little matched pair of plastic transistors (phono preamp sized) supplied the drive currents to their power mos-fet outputs. I found this to be a bit surprising as little plastic transistors are, in general, only good for 100 milliamps of current or so before melting, and, in general, power mos-fets require healthy input currents to charge and discharge their inherent gate capacitance. Is it a "done with mirrors" circuit?

At Bedini, a little "black box" was the new magic item, claiming to "match speaker wires with amplifiers and speakers" – or something like that. I asked what was in it and how does it work and was told that the explanation was "too technical." I said, "Try me," and they went gasp-choke oh no-no-no. I will admit that Bedini might need some "black box" help as others have reported their amps tend to blow up into capacitive loads such as Polk cables. Such fun I had at the show.

One company (I forgot the name) displayed a magic moving coil cartridge electronic damping box that feed back some kind of signal into the cartridge to damp its mechanical and electronic ringing (at least there is hope – someone else besides us recognizes the underdamped high frequency oscillations inherent in most moving coil cartridges). Unfortunately, their box turned their display cartridge from awful-harsh to awful-dull and after that who cares about spending several hundred more to get your several hundred dollar moving coil cartridge to work. Why not just give up and buy a digital disc player?

To interject – we recently did find one moving coil head amp that has a good chance of working well – the Hafler head amp as available in the DH-101 preamplifier, after we have replaced the original preamp circuits. We recently got in a 101 with the head amp and found that we could “salvage” the head amp, our board set would fit just fine and our power supply would interface with the Hafler head amp circuits. In testing, I dug out my trusty Denon moving coil cartridge, and surprise, it sounded pretty darned good for the first time. Evidently our phono preamp, which does not overload on high frequency transients, together with our low impedance power supply, helped the Hafler head amp a lot, and the end result was acceptable musical sound. If you have just got to run a moving coil cartridge, you might give our SUPER-FET 101 preamp with the Hafler head amp a try, I have not heard anything better for this application.

We got a good look at the new AR turntable and its own arm looks just fine. The president of AR claimed he would get me an evaluation sample, but later we got a terse note from some staff executive telling us they were not interested in us as a dealer and thus no chance to evaluate the unit here. Their only area outlet is a discount warehouse, where, at the last “warehouse sale” had the \$450 list price AR table with arm “on sale” at \$599, \$499, or \$399, depending on which salesman you asked, with a claimed list price of \$699, and not a single unit on display – just dusty boxes piled along with all their other trash. I guess that is the new look in “marketing.” I suggest you buy something else unless we do get an opportunity for a “hands on” evaluation.

The chief turntable engineer from Harman-Kardon spent some time with me (they knew about our recommendation of the T-60 in *Audio Basics*) showing me their newest turntables. The T-20 and T-40 have been replaced with a T-25 (about \$189 list price), a T-35 (kind of “in between” the old T-20 and T-40), and a T-45 (“in between” the old T-40 and T-60). The T-60 continues in production with minor improvements to its suspension. I was told that H-K would send me a “reject” T-60 tone arm so we could tear it down and find out how to get into the vertical bearings for silicon lubrication, but that was in early January, and even after one follow-up letter to them since then, no arm has arrived here yet. Watch this space next month. All of their turntables seem to be competent.

Kodak was showing a nifty new video cassette (8 mm – about the size of an audio cassette) camera – VCR unit that is probably making the manufacturers of the “full-size” units a bit nervous. First of all it was working really well, with better resolution, color balance, and focus than I am used to with “home” video cameras. It didn’t tend to “run” on bright lights either.

Second, it was light enough to carry. You could actually handle the about 5 pound combined VCR-camera unit without terminal backstrain. The battery (rechargeable) was about the size of a cigarette package so you can even stick a spare in your pocket without extra strain. Control layout and function was just fine, and all in all, I expect Kodak stock to go up again as people see that big yellow “Kodak” logo on quality video equipment.

Home use of the unit was interesting too. Since the video recorder is built into the camera, for home playback thru your TV, the camera, with lens portion folded back, fits into a “cradle” containing the connections to your TV set and battery recharger. It ends up the size of a small normal video recorder and interfaces with your TV easily. Finally, a “tuner” module can be added for recording from your TV, cable, or satellite receiver the same as any other video recorder. Obviously, you can copy tapes from the tiny Kodak 8mm format to your larger Beta or VHS system (useful too for “editing” long boring home video movies – and you don’t know how boring “home movies” can be until you give someone a camera with 90 minutes of record time at a shot rather than the 5 minutes or so available on film). Hopefully, I will get a sample from Kodak to play with this summer as they reach full scale production.

There were lots of lower cost digital disc players at the show, but nobody seemed yet to know that they better start good RFI shielding in them. The new NAD unit has a dealer cost of about \$400, again telling you not to pay too much for one.

I actually sat in several car radio displays from some of the big time “super-hi-fi – and expensive” car audio purveyors. Ha, ha, ho, ho, he, he, – they still are all terrible (if not worse). Give those idiots a chance with half a dozen 8” poly woofers mounted right behind your ear and amps so huge they had racks of truck batteries running them and they will kill you – blow your ears right off – with wide range distortion – no music to be heard, anywhere. The biggest disappointment was with the display set up in a Lamborghini Countach (the \$100,000+ super car raved about by the esoteric auto (not audio) press) – front and rear wings and all. The disappointment was the car (I never turned its “audio” system on at all!). The interior workmanship was terrible, it looked like an amateur copy of a fiberfab kit car – a parody of a copy of an original. The seats were hard as rocks (K-Mart captain’s chairs with lots of Naugas sacrificed to cover the plastic). There was not room for a bag of Fritos, let alone enough goodies to travel with cross country. It did look neat though, until you noticed none of the panels fit (would have made Prealocca Chrysler Corp. proud). Come on now autophiles, if you want a race car for the street, buy an out of date CART racer (lots of rolling

chassis available for \$20,000) and throw a fiberglass shell on it – don’t screw around with high priced FIATS.

STOP THE PRESS! Our friendly UPS man just arrived with the Mission 70 MK II loudspeakers. It is a small (14” x 8 1/2” x 8 1/2”) two way system using a synthetic laminate 6” woofer and a film dome 3/4” tweeter and a rather typical 12 dB per octave crossover. Workmanship and component quality are outstanding for the price. Sonically, this is one honey of a loudspeaker system! It is, in my opinion, the most musical and natural sounding “budget priced” loudspeaker system I have ever heard – very superior in definition, balance, imaging, to the over twice the price Spica TC-50 and as good as the latest B&W DM110 except in bass extension (but better than the Spica). It is efficient, dynamic, and plays big! It has no “box” colorations or “echos” at all, which is a first for a low cost loudspeaker in my experience. Perhaps the complete foam fill internal insulation and cork decoupling of the woofer from the box is responsible for this. Certainly the construction materials, methods, and execution are far superior to those I have seen in other budget loudspeakers. What are its shortcomings (compared to much more expensive loudspeakers)? In general, none – as it will outplay, musically, most “expensive” loudspeakers. If we start comparing it to the few really superior loudspeakers (many of the B&Ws, Celestion SL-6) and get “picky” then we can hear a bit of roughness (not severe harshness) in the upper end (really picking nits here), and of course the box and woofer size eliminates the really powerful deep bass – but, midbass is clean (no boom or mud at all) and the lack of deep bass does not give the speaker the “squeaky” high pitched overall midrange sound of so many small speakers. It is simply the bass of the \$200/pair Mission 70 MKII does not extend as deep as the \$300/pair B&W DM 110. If deeper bass (all other things being nearly equal) is important to you and you want to pay the extra \$100 for it, buy the B&Ws. If you want exquisite sound at a rock bottom price, there is no other choice we know of that comes close to the quality of the 70 MKII. We suspect, in addition, this would be one of the better candidates for possible addition of a sub-woofer later: 1. It is efficient and clean and low cost so the overall cost of a complete system with a sub-woofer still will not get in excess of the cost of a comparable full range speaker system. 2. As is, we suspect you will like it, as the overall balance is good, so it makes a starter speaker you can live with. This assumes of course that you can find a good sub-woofer (we have not yet). I could also compare this speaker with the Pyramid Met 7, with the Mission having greater range, better balance, better dynamics, and without the “silvery” top end of the Met 7 (and at a much lower price, a

much better buy). The bottom line, if a \$200/pair loudspeaker is all you can afford, nab these off now, before Mission realizes how good they are and raises the price. [1990 Note: *The Missions have now been superseded by several generations of small B&W speakers that are much better and much better values, such as the DM560s and the V202s.*]

One afterthought, the Mission 70 MKII loudspeakers sound, in our studio, as I remembered them at their C.E.S. display (which impressed me enough to order an evaluation set). An implication then is that Mission's electronics might be doing a pretty good job too. If you don't want to do business with us, I suspect you ought to audition all of the equipment Mission builds, they cannot be doing things too badly.

The home computer (and electronic game) market is just falling apart. The "marketer's" visacalc programs have been running in the great computer enhanced guess mode projecting vast expectations for half-vast products. Interesting observations from the show:

1. Only one "new" product introduced, Commodore 264 and 364 models, essentially 64s with some built in ROM based software. They were received so well, the president of Commodore resigned shortly after the show (along with most of the top management staff).
2. Coleco showed normal disc drives for the Adam, essentially admitting that their stringy tape drives were a bust (both in reliability and in slow access time). This great addition to the Adam makes the system just as expensive as anybody else's toy computer which is not the original premise of the system. According to Mart, an industry trade journal, people are so excited about the Adam that Coleco just laid off about 70 executive type people.
3. Panasonic is pulling out of the U.S. home computer market completely – cannot afford to keep up with the price war on toy computers – interesting to see a Japanese company driven out of a market by being undercut in pricing by U.S. companies.
4. Apple introduced the Macintosh "computer" (really an executive toy for those not competent enough to learn how to operate an IBMPC). It has no expansion capability (they claim that in the future, 256K RAMS can replace the 64K RAMS to increase memory). There are a few "catches" to this: 1. 256K RAMS take more power supply current, better supply decoupling, require better memory board layouts, probably different timing relationships, and additional bit codes for accessing memory. 2. Quality, low power, low priced 256K RAMS are still a figment of designer's imaginations. 3. Heat

dissipation is four times higher, all other things being equal. (For your information, the HP-9000 uses H-P designed and built 128K RAMS each containing 600,000 semi-conductors and their 256K memory boards cost about \$3000 each – executed very well. If you think you are going to stuff cheap 256K RAMS into a Macintosh "as is" and get more memory, think again). Finally, Apple too, along with IBM is in the LIAR AND FRAUD mode. They call the Macintosh a "32 bit" computer. Its processor is first generation Motorola 68000 16 bit processor which has a 16 bit data bus. To quote one manufacturer (Hitachi) of the 68000, "The 68000 is — an architecturally advanced 16-bit microprocessor." (Page 253 of the Hitachi 8/16 bit Multi-Chip Mircocomputer Data Book #HLN062). Of course the IBM PC and PC Jr. are 8-bit computers (as are all other 8-bit 8088 based computers). Our suggestion, don't do business with people that lie to you. One other comment on the quality of the 68000 processor by Jack W. Browne, Jr., Motorola's manager for marketing and applications engineering of advanced micro-computer components (from Feb. 20, 1984 issue of *Electronic News*) "When we did the 68000, we didn't understand the nature of the beast." Enough said.

[1990 Note: *How things change! Now this is being edited on a Macintosh IIx which is a true very fast 32-bit computer which is a much better overall machine than the HP-9000 and is priced an order of magnitude less. Memory - 4 meg chips are now available and those 256K chips longed for in 1984 are now obsolete.*]

5. By now, we assume you know Texas Instruments has dumped the entire TI99/4A system and support for it (and outside suppliers are getting out of ROM cartridges for it too) after losing their ass building millions selling for \$35.00 under their cost. Clever!
6. You may not realize that Mattel is dumping the entire Intellivision game system and Aquarius computer system (its turned into a huge dollar sink for them) and that Milton Bradley (which lost \$18,600,000.00 in 1983) is discontinuing both its Vectrex games and its GCE video arcade games. Both Imagic and Activision, major outside suppliers of Atari games, have had big losses and staff and production cutbacks. Most other smaller game makers are long gone, leaving large piles of discontinued and boring ROM games lying in \$5.00 piles at local discount houses.

One problem, of course, is that it is possible to design and market a few really long term interesting video games, but, the market is so overstuffed with trash that nobody can afford to engineer, tool, produce, and fill distribution pipelines with quality products until the trash clogging the works is disposed of. The other problem is that last years Visaguess program told all the executives to "build jillions of video games." They did, they lose. They forgot to build good video games. Now the Visaguess program says "nobody wants video games." Wrong again, nobody wants bad video games. They will never learn.

7. Finally everybody who last year was making Apple copies is busy building IBM copies this year. (Isn't there an original thought anywhere in the industry?) Of course what they don't tell you, and what you don't know is that IBM dedicated software will not run on "IBM compatible" machines. Why not? Because not all of IBM's code is in the disc loaded operating system or inherent in the 8-bit 8088 processor. Some is in dedicated IBM logic arrays used for driving the screen, I/O devices, etc. If the programs are written for best operation speed and execution using the dedicated IBM hardware, you lose in trying to run those programs on your Kumquat, Corolla, or whatever, you crash and burn, for the copies don't have IBM's dedicated hardware chips. Don't expect fast delivery of that new and better 8088 clone machine either. Right now Intel is quoting as much as one and a half years lead times for processor chip delivery and the much more modern true 16-bit 80186 processor (as used in the Radio Shack 200 – and intended for the IBM PC Jr. but not used there due to availability and design problems) is backlogged too.
8. In Taiwan, even the rip-off Apple copy artists are in trouble, as nobody wants their imitation Apple IIs any more and they cannot get enough 8088 copy chips to build IBM copies (and IBM will probably nuke them if they try).

Our prediction: Within two years, the entire "personal computer" business, as we know it, will be a complete wipeout, with huge losses for everybody in the business, including IBM. About the time IBM scales up production to "meet demand" the demand will suddenly go away and a repeat of the video game business will occur. I can think of no worse investment to make today than venture capital into a computer store "franchise." They are going to be as gone as Nash and Hudson dealers. Wait and see.

[1990 Note: Well – I sure blew that prediction, didn't I!]

*International Audio Review* claims they have “invented” a “new” Wonder Cap that is much more wonderful than their “old” Wonder Cap (you know, the ones you ordered from them and paid for and didn't get, six months later). In fact, their new Wonder Cap is so wonderful they have set up a separate company, TRT to sell them to you. I “wonder” if this is so when TRT doesn't deliver what you paid for (as many past complaints against IAR have claimed) that then you will only be mad at TRT and not at IAR. Old Wonder Caps don't even come close to passing IAR's listening test now. Does that mean that IAR couldn't hear before, hears “better” now, or do old Wonder Caps deteriorate in quality very quickly with age? What are you going to do with all those expensive old (now bad sounding) Wonder Caps you bought? Have fun. By the way, you do need to, according to IAR, bypass new wonderful Wonder Caps with new wonderful small Wonder Caps for good highs (a one for the price of two sale?). Does this mean big wonderful Wonder Caps are not really wonderful? One real problem here – IAR claims their caps are so wonderful that their 4 microfarad unit can be used to replace anything of .1 microfarad or up in your electronics! WRONG! Changing pole points by two orders of magnitude randomly is not good engineering, it is guessing! If a unit is competently designed, every capacitor value in the unit will have been selected for good engineering reasons to provide optimum pass characteristics for that circuit topography. Random changes in capacitor values will be as disastrous as going out with a chain saw and chopping off part of the wings of a 747 to make it “fly better.” If, on the other hand, the designer of the unit didn't know what he was doing, and capacitor and topography concepts of the unit are screwed up in the first place, magic capacitors will not cure its design problems (magic wings won't make a cast iron 747 fly). If you “believe” IAR you better run down to your local library and check out the book, *Everything Magic Has Done to Improve the Lot of Human Lifestyle over the Past 2000 Years..*

Van Alstine's Law #2. When you substitute beliefs for knowledge, you stop learning.

Van Alstine's Law #3. When you substitute beliefs for knowledge, you cannot learn.

Van Alstine's Law #1. Mother Nature doesn't give a shit.

#### Enough editorializing, time for CRASS COMMERCIAL MESSAGES:

1. We have found (by having a bunch of equipment dropped in upon us by our Swiss connection) that our SUPER-FET preamp circuits interface very nicely in

the Crown IC-150 preamplifier, complete with our precision volume and balance controls and 5 new PC card audio circuit set (shunt regulated power supply, 2 phono boards, and 2 line-output boards). The final layout is cleaner than Crown's original layout and the unit is very low noise due to Crown's well shielded power transformer. Our rebuild price, including return shipping in the continental USA is \$395.00.

2. Likewise, our MOS-FET 150 circuits fit really well into the Crown D-150 power amplifier (like the amp was designed for our cards and mos-fet output layout instead of theirs). The result is a lovely sounding, dynamic and stable 50+ real watts per channel and no more hard, sterile sound. Cost? \$395.00, to convert your Crown D-150 amplifier into a modern mos-fet amp.

*Frank Van Alstine*

### VOLUME THREE NUMBER THREE MARCH, 1984

“Odds and Ends” time.

A reader has called a neat little device to my attention, a Radio Shack TV interference filter that has helped his FM reception. There are two versions, the 15-580 at \$8.95 for 75 ohm coax antenna cables, and the 15-581 at \$5.95 for 300 ohm flat antenna cables. The device goes in line with your antenna cable at your tuner and filters out of band trash (CB, Ham, AM, and other RFI garbage) before the FM signal gets to your tuner, thus making life easier for the internal circuits. Todd Cirilli claimed it gave him much more musical performance from his tuner and at the low price, you might want to try it too.

A word of caution for those of you doing the SUPER-PAS modifications. Although we have successfully installed thousands of Noble controls, one of our clients managed to melt the contacts in both the volume and balance controls we supplied with excess soldering heat. Thus, take care in soldering these controls and treat the leads as if they were transistor leads and heat sink them before soldering.

I recently received a thoughtful letter from Peter Hayward of B&W Loudspeakers of Worthing, England. He informed me that B&W will have retrofit kits available this summer to change over 801, 802, DM7/II, & DM17 models to the new TZ26 series tweeter. He also offered to send me a pair of replacement tweeters for my own reference 801F speakers for evaluation ahead of normal production. I of course accepted his kind offer and will report back to him (and you) how we perceive the new tweeters as a retrofit to existing B&W models. We have not received the new tweet-

ers yet and it will probably be a couple of months before we are ready to report on them. Watch this space! In any event, there are not many audio companies that take as much care about existing and past customers as B&W does. They are true professionals.

In the November, 1983, issue of *Audio Basics*, I noted that Linda Ronstadt had an uncredited “backup” singer in her record, *Simple Dreams*. I asked if any of you could identify the singer. No response yet! Come on out there, who is that backup singer?

We recently received an interesting letter from Andy Fuchs, of GSI Audio, P.O. Box 158 Station A, Flushing, New York 11358. Andy does modifications to, and has parts and tubes for, many vacuum tube amplifiers. I noted two things of particular interest. They have 6CA7 output tubes for Dyna St-70 amplifiers available for \$8.00 each (made in Hungary) that are probably worth considering. They sent me a schematic of one of their extensive Dyna St-70 rebuilds. I noted they use a completely new voltage amplifier section, kind of a vacuum tube differential amplifier input section. Inasmuch as the stock circuit demands a high quality 7199 tube, and these are getting mighty hard to find, those of you that are really into vacuum tube power amps should look into this GSI circuit (our observations regarding input filtering still apply no matter what the circuit configuration is). Please understand our observations are not a firm recommendation (we have not yet done business with GSI or tested or heard their circuits). However, they have had the integrity to send us schematics of some of their products which takes them far out of the “deep dark secret” and “magic capacitor transplant” mode of operation and into the worth considering class. If any of you have done business with GSI, I would appreciate your feedback. In any event we suggest those with vacuum tube interests write GSI for their catalog.

We have finally had the opportunity to evaluate the new AR turntable in house (no thanks to AR who's President reneged on his promise to get me an evaluation sample) and the result is no-go – not recommended. The unit has an unshielded AC motor and a large AC hum field which inducts annoying amounts of hum into phono cartridges (just like the Linn Sondek). The original AR used a similar motor, but had a complete metal plate separating the motor from the platter and arm mount, the new AR has much prettier, but much less effective, walnut shielding – i.e.: no shielding. Thus it hums (doesn't know the words?) and we revert back to recommending the Harman-Kardon turntables as the most cost effective now available. In any event, the H-K T-60 has a better platter (damped), no hum field, an equivalent arm (the AR arm is just fine), variable speed without fumbling with belt pulley changes, an

end of record lift off, and a suspension just as stable as the AR unit and at a lower price. The choice is obvious – Harman-Kardon turntables.

Regarding the original AR turntable, now is a good time to discuss how to make one work better than new (better than almost anything else you can buy new too).

The original AR turntable was a classic and a winner. It had excellent isolation, a good bearing, a stable platter, a quiet motor, and a tone arm that got lots of gripes (but one that can be made to work very well indeed as we shall describe). AR turntables in working order (no excess bearing wear) are still well worth owning and using. The following is what we do to overhaul and improve an original AR turntable and arm. Note that most parts are still available directly from AR Customer Service, 10 American Drive, Norwood, MA 02062.

If you have the oldest AR with two motors (one drive motor and a smaller “starter” motor, belt coupled to it) you must first change motors as belts are no longer available for this configuration. AR makes a replacement kit for these oldest units, retrofitting to the later single motor and drive belt configuration, complete with instructions and all necessary parts. Contact them for details, the original two motor setup is obsolete.

Assuming a current one motor configuration, the first step is to remove the platter and drive belt and remove the tone arm. Caution! The tone arm wires don’t remove and although you have enough slack to remove the arm and place it on the baseplate to work on it, trying to move it further will break the wires and ruin it. The arm removes by first removing the cartridge shell and cartridge to a safe place and then unscrewing the arm post so the arm, with cast bearing assembly structure, lifts off. Remove the arm post from its bearing well. Notice if a small ball bearing comes out with the post. If it does, pick it from the post end (its held there only by “stale” lubrication) and put it where you will not lose it. If the ball bearing didn’t come out with the arm post, a “two man” job is necessary. One person holds the tone arm and turntable (so the arm wires cannot break) and tips the table upside down. The other person puts hand over arm bearing well and catches the ball bearing (about 1/4” across) when it falls out. Both people then crawl around on hands and knees looking for ball bearing when it bounces out of hand onto floor – hint – the cat ate it. Anyway –

You will need the following supplies: Ronsonol lighter fluid for degreasing bearings and pulleys, Q-Tips for applying Ronsonol, new lubrication – check with AR for their recommendation (we use 1000 centistroke Dow Corning 200 fluid – a pure liquid silicon – sorry we cannot supply you directly as we have only one

small sample can – it normally comes in 55 gallon drums for industrial purposes – if you have a Dow Corning factory representative in your area perhaps you can talk him out of a sample – might also be available through medical sources), and if the little foam plastic oil retaining ring at the top of your platter bearing well on the AR looks like something the monster from the green latrine rejected, acquire a new one from AR. You will also need a jeweler’s screwdriver for adjusting the arm bearings.

If the plastic foam oil retaining ring has degraded, insert a few Q-Tips into the platter bearing well to catch the debris and remove the remains of the foam ring. Then pull out the Q-Tips with the remaining particles. Use Ronsonol to thoroughly clean out the bearing well, the arm bearing well, the platter bearing shaft, the arm bearing shaft, the arm ball bearing, the motor pulley, and the rim of the platter where the belt goes around. Do not use Ronsonol on the rubber belt – it will degrade it (again, replacement belts are available from AR if needed).

Now to “fix” the AR horizontal bearings and turn the arm from sloppy, sticky, and ho-hum, into smooth, precise, and clean. AR had all the right parts there, they just used them improperly. The problem is the attempt at “damping” between the outer casting and the brass cylindrical bearing holder. In essence, the outer sleeve bearing is sticky and the inner cone bearings are sloppy and this can be fixed.

Using a jeweler’s screwdriver, “back off” the two cone pivot bearings on each side of the outer casting until the chrome cylinder and inner brass cylinder can be removed. (We will be “locking up” this “damping” assembly completely as it never worked well and screws up the arm performance). The inner brass cylinder will now slide out of the chrome cylinder. The pin protruding from one side of the brass cylinder can be removed by pulling firmly with a pliers. Remove it. Now thoroughly clean and degrease the two cylinders with Ronsonol. Also clean the arm mounting post and remove the plastic clip and remnants of a foam pad from the arm end of this post.

Clean the plastic inserts in each end of the brass cylinder. Note that these are the “real” horizontal bearings, in which the cones on each side of the casting ride, and properly adjusted and lubricated, will provide excellent arm stability and sonic quality.

After the arm post, arm bearing well, ball bearing, brass cylinder, chrome cylinder, and arm casting are completely cleaned it is time to put the arm back together. The brass cylinder goes back into the chrome cylinder with the “flat” pointing down towards the arm post mounting hole (it interfaces with the arm post

when the post is screwed back on). A drop of 1000 centistroke liquid silicon (or AR approved lubricant) goes into each plastic bearing insert in the brass cylinder. Locate the chrome and brass cylinder assembly in the outer arm casting and carefully screw in the cones on each end of the casting, engaging the plastic bearing inserts. Screw these cone bearings in so that the cylinder assembly is centered in the outer casting and located with only a little “slop” in the bearings. Do not over-tighten or you will damage the plastic bearing inserts in the brass cylinder.

Now lubricate the arm bearing well with 10-15 drops of silicon (or appropriate oil) letting the lube run down the sides of the well, drop the ball bearing back in, make sure the arm post has a good film of lube on it, and install the arm post in the bearing well. See that the ball bearing is seated in the bottom of the arm post. Lift the arm assembly back on top of the post and screw the arm post back into the assembly, making sure the projection on the end of the post goes back into the center groove in the brass cylinder. Tighten the post firmly, locking the post to the brass cylinder and chrome cylinder. The arm should now rotate very smoothly both horizontally and vertically on the cleaned, re-lubricated, and readjusted bearings, with very little slop or play. (The final cone bearing adjustment will be done by ear after the setup is complete.)

Lubricate the platter bearing well with 10-15 drops of liquid silicon and coat the platter bearing spindle too and reinstall the platter and drive belt. If your foam mat is in bad shape we would suggest it be replaced with a Tri-Pad damped platter mat (available through Monster Cable dealers or direct from Monster Cable, 101 Townsend St., San Francisco, CA 94107, price \$30-\$40). Set up cartridge properly (that’s another complete project to come), rebalance, and reinstall table in your system.

Now comes the final bearing adjustment by ear (one you will have to occasionally re-check as the bearing adjustment will move with time and use). Starting with a setup in which there is only a small amount of play (slop) in the cone pivot bearings (you can feel the play by gently twisting the arm from the headshell end), play a dynamic record containing detailed highs and bass. If the arm bearings are adjusted too tight, the arm will bind slightly, and the sonic quality will be “stifled” – compressed with a small, undynamic sound stage (sorry about getting into “arm-waving” audiophile vocabulary but there isn’t any other good way to express these subjective perceptions). If the arm bearings are too loose (too much slop) the sound will get bright and “hashy” sounding (from excess arm resonances and bearing rattle).

Making careful and small adjustments with your jeweler’s screwdriver, either tighten or

back off the cone bearings until the sound stage is smooth, dynamic, and big. If the whole works has been silicon lubricated, both the platter and arm should have the feel of "greased glass" and the overall sonic quality will not be exceeded by any other table and arm, no matter how expensive or exotic. In other words, if you can find a good used original AR table at a reasonable price, buy it, set it up as above, and use it, you won't do better.

We got two more new B&W loudspeaker models in recently. A recent production model DM220 (\$500/pair three way) and the newest DM3000 (\$1800/pair large 3-4 way system). Both impressed us a bunch. The DM220 (which is the bigger version of the DM110) has been "fixed." The early samples we got in last summer underwhelmed us – harsh – boomy – colored. These are smooth, tight, big sounding, and neutral. Whatever problems B&W had with early production DM220 models has been completely cured and we can now suggest that you won't find anything that will play better, or bigger, at a rational price. The new DM3000 is something else! (Its the "big brother" of the DM2000 previously reported on but with two active bass-midrange units and a larger passive radiator). It is extraordinarily dynamic, very, very smooth, very neutral, and has outstanding imaging. To pick nits, the very deep bass is not quite as "tight" as the nearly twice as expensive 801F, but the power and dynamics are better than the 802F and the bass is still cleaner and faster than anything else I have heard at this price (or twice this price for that matter). In my book it is the speaker B&W has been trying to make in the DM16 and DM802 (but didn't quite achieve) and has now "hit the jackpot" with. It will make a lot of people think twice about spending any more (or less) on a speaker system. In essence, nothing less expensive is as impressive, and nothing more expensive is significantly better. One neurosis – the speaker has a tall, flat topped cabinet, and I keep thinking – I wonder what a stacked pair would sound like – especially if they were bi-amped? Oh oh – strike that thought - I am not supposed to be suggesting normal "audiophile" advice – still – I wonder. Our suggestion, if you can afford them, buy them now before B&W realizes they should charge a higher price for them. (Top end is mighty sweet and detailed too.)

We made the "big time." Finally, after many, many years, one of our products has been reviewed in *Stereophile*. We understand that J. Gordon Holt has reported he thinks our MOS-FET 120B amplifier is a "best buy." We have not seen the finished review yet, but most certainly will ask for reprint rights if possible. We sent *Stereophile* a SUPER-PAS preamp recently too, so watch that space for further comments. We can comment that *Stereophile* has finally gotten on a reasonable publishing schedule, with a more professional layout, and

seems to offer some "gems" of advice (along with some advice we do not agree with at all, such as long evaluations of what is the best magic interconnect wires). However, the magazine is interesting and not as hard to read or agonizing as *The Absolute Sound* and we suggest you give them a subscription try. We got a confirming review of the MOS-FET 120B amplifier from another unusual source last month too, the Sunday, February 12, 1984, issue of the *Buffalo News*. Mr. Tom Krehbiel wrote, in his World of Stereo column, "Mr. Van Alstine demonstrated his service and circuits for me by changing a Dynaco St-120 into a MOS-FET 120B amplifier. As far as I'm concerned, the operation was a total success and listening to (or through) this amplifier has restored enjoyment and excitement to my stereo listening that I didn't even know was missing." That's all a review really need say, you don't need ten pages of fine print to describe an amplifier (unless it is a \$3000 vacuum tube unit that blows tubes and other parts so rapidly and often that even the company owner cannot keep it running as reported in a recent TAS – but still wonderful of course – even though it won't work reliably).

O.K. folks, how about an equipment survey to allow me to know what to write to better serve you and to allow you to see what is used out there by my readers and to "nudge" you to suggest topics for *Audio Basics*. Please return this page (or a copy thereof) (and an additional sheet if necessary) to me in time for a results report next month.

What Loudspeakers do you now own?

What loudspeakers have you owned and given up on in the past, and why?

What Turntable and Phono Cartridge do you now own?

Previously used?

What Amplifier, Preamp, Tuner, and/or Receiver?

Again, describe past units, and why you changed.

What Tape Deck do you use?

What brand & type of tape?

Again, describe previous units and why you parted company with them.

What has been your most troublesome audio component? Why? How resolved?

What would your choice of a "dream system" be (price no object)? Why? Lets get some good thought here – it should be interesting to others.

Any satellite receivers out there? Your experience with them?

Finally, give me some more topics to cover in *Audio Basics*. I have got to have input from you to write about what you want.

*Frank Van Alstine*

## VOLUME THREE NUMBER FOUR APRIL, 1984

Hello again! We are getting an amazing response to our equipment survey questionnaire, nearly 10% of you have sent in your filled in response along with many additional detailed letters. Since more results are coming in each day's mail, we shall wait another month before tabulating and publishing the result of the survey as to publish now would cut off too many of you. Please return the survey questionnaire from last month *Audio Basics* now so we can get as useful results as possible. Note that a typical response from a magazine survey is far less than 1% (for example, *Analog* pays a bonus to its writers for work its annual reader survey rates best in each of several categories, and the results are determined by less than 200 responses out of a readership of many thousands).

One of my readers, Bob Green, has given me a source for Dow Corning 200 fluid (the liquid silicon I mentioned last month in the AR turntable rebuild article). I wrote to the company and obtained a catalogue. They produce and sell all kinds of exotic lubricants – such as for watches and cameras – and do sell the Dow Corning liquid silicon in one pint cans. The company is:

William F. Nye Company  
P.O. Box G-927  
New Bedford, Mass 02742

Although a one pint can of Dow Corning 200 fluid (1000 cs.) is just \$7.00, the company does have a \$20.00 minimum order. Another useful and very hard to find product is the same 200 fluid, but at 300,000 cs. This is heavy viscosity used in tone arm damped cueing mechanisms. An 8 ounce jar of this material is \$9.50 (enough to redamp several thousand cueing devices). I suggest that some of you get together (especially Audio Clubs) and order a unit of each and have a make your turntable work session. (Are you listening, Pacific Northwest Audio Society?)

As a follow-up on the AR tonearm rebuild, I did hear from one very happy reader. He had previously purchased a preamp and then a Longhorn Grado cartridge from us, but still complained he was not getting good sound with his AR turntable. In going through his AR turntable-arm as we described, and getting to the step about removing the little ball bearing from the bottom of the tonearm well, he discovered that in his unit, the ball bearing was missing! The tone arm had been grinding away

without a bearing for many years – no wonder his sound was not too wonderful. He bought an assortment of bearings from a local machine shop, found one that fit perfectly, and finally, the system started working properly. The point – there is no way we can predict every possible cause you may have for poor sonic quality in your system – and unless you investigate everything, making no assumptions, you may spend lots of money searching for good sound when the problem may be as simple as a missing 5¢ part. No, our equipment is not going to “sound good” if you are missing a tonearm bearing. Are you sure everything in your system is working properly? Are you really sure?

I am going to call your attention again to a test instrument that every serious audiophile should own, the new Fluke 73-75-77 series precision multimeter. This is a new 4.5 digit autoranging, autopolarity precision meter for measuring current, voltage, resistance and diode polarity. It has the accuracy and ease of use that would have cost \$500+ only a year ago. There are three models. The Model 73 is \$85.00, the Model 75 is \$99.00 and is more accurate, and the Model 77 is \$129.00 and has a few more bells and whistles. A case (C-71) is available for \$9.00 and a delux test lead kit (Y-8134) is available for \$20.00 (not really necessary as each meter comes with adequate test probes standard). The model we recommend is the Fluke 75 at \$99.00. These meters are new designs, using custom large scale integrated circuits, and make older designs look like cheap kludges. Although they are available from many sources, we will give you one source we know that does stock them and that we have done business with:

Gopher Electronics  
Attn: Kathy  
222 East Little Canada Road  
St. Paul, Minnesota 55117

Gopher will pay shipping on orders to states adjoining Minnesota. If you live in Minnesota add 6% sales tax. If you live further away, add \$5.00 for UPS shipping in the continental U.S.A. Again, the Fluke 75 precision multimeter is a must for anyone interesting in electronics.

Caig Laboratories, makers of the great contact cleaner, CRAMOLIN RED, is getting ready to offer a special consumer cleaning package of special R-2 Cramolin Red. It will be a 6 ounce spray can, complete with a set of special audio contact and jack cleaning brushes and swabs, for about \$9.00 retail. In the past, consumers have only been able to get Cramolin in messy little bottles as the industrial spray cans used a freon based propellant not legal to sell to retail consumers. Caig Lab has now developed a “government approved” propellant that does

not interfere with the Cramolin’s cleaning and contact preserving ability. We suggest you contact:

Caig Laboratories, Inc.  
Attn: David Getoff  
1175-0 Industrial Avenue  
Escondido, California 92025

Ask for a catalogue and the name of a retail dealer in your area where you can purchase the new Cramolin Red R-2 spray contact cleaning kit. Again, Cramolin Red is the best contact cleaner we have yet found, and it will take the noise out of old controls, restore intermittent switches, and clean the corrosion from jacks and audio fittings and keep them clean and noise free. Nothing else comes close.

As long as I am giving you sources, I might as well give a source for Corning precision 1% tolerance metal film resistors (RN60D 1/2 watt). You can get them from Ragon Electronics, 2525 Wabash Avenue, St. Paul, Minnesota 55114. The cost is 10¢ each. There is a “catch” and that is they come packed in 100 lot packs, and you must buy a minimum of 100 pieces of any given value (\$10.00 + shipping).

Another good parts source is Digi-Key Corporation, Highway 32 South, P.O. Box 677, Thief River Falls, Minn 56701. They stock high quality Panasonic capacitors and precision resistors and do sell in small quantities. Write to Digi-Key for their very interesting and complete parts catalogue. We call your attention in particular to their TSW and TSS series of miniature power supply electrolytics which can allow you to build a very stiff and low impedance power supply in a very small space, and to their V-Series Panasonic miniature stacked metalized film capacitors which are precise, very stable, and superior for coupling and tuned circuit applications. These are “new technology” capacitors, not obsolete huge “soft film” inductive wound capacitors made on third hand equipment in Sri Lanka for the purpose of keeping 1930’s radios running in third world countries (and so obscure they can be pawned off as “magic capacitors” at outrageously high mark-ups by snake oil audio salesmen).

Speaking of outrageously high prices, we noted in a recent *Sensible Sound*, a letter from a “magic cable” manufacturer, claiming he was selling his brand of “magic interconnect cable” for only \$4.00 to \$6.00 per foot (depending on the strength of the magic) out of the “goodness of his heart” for altruistic reasons only because he had great concern for the limited budgets of audiophiles and thus kept his prices, and thus profits, “very low.” Ha! We found the cable he used (a stock Belden 75 ohm coax) in the Belden cable catalogue at 27¢ per foot in 100 foot rolls. We sent a copy of the catalogue and price sheet to the editor of *Sensible Sound*,

pointing out that \$6.00 a foot retail in comparison to 27¢ a foot didn’t sound too “altruistic” to us. So far no response from *Sensible Sound* to our hard data. Do they like “claims” better than data? When is this magic parts and magic cable bullshit going to stop?

Again, we have never had anyone pick out any sonic difference between any two brands or types of speaker wire or interconnect cable in a test in which the listener did not know what wire or interconnect was in the system at the time, and did not know what was being switched, or if it was being switched or not switched, and when the system gain was adjusted to make up for any minor wide band resistive loss in a small gauge speaker cable. (*Stereo Review* did not take this into consideration in their now infamous Monster Cable test and some people could of course hear the slight level drop of the increased resistance of small gauge cable in comparison to Monster Cable. If they would have carried their test only one step further, first measuring the slight difference in loudness and then adjusting the volume control to match output loudness when switching cables, I suspect nobody would have made a meaningful judgment of the different speaker wires’ “virtues.”) Our insight - it is less expensive to turn up your volume control one step than it is to purchase new heavy gauge speaker wire.

This might be the time to point out that real quality does “pay off” in audio engineering though. For example, for several years we have used National LF356J Fet input linear op-amps in our Super-Fet preamp series. This is a plastic case device, 8 pin mini-dip package. Although the unit cost is low, our actual cost per usable device was quite high, as after culling for popcorn noise, our yield about one out of three devices purchased. We recently changed to a Motorola LF356H version of this same device. It is the identical internal circuit, but in a high reliability ceramic package. Our yield is now over 90% with the H (ceramic) package LF356. So, even though the initial cost is over twice as much, our actual cost is less than using the plastic case IC as the yield is so much better (and we should have even better long term reliability too). Spending more costs us less in this case.

Unkept promises department. At the C.E.S. show last January, the Technics regional sales manager promised me a SL-P7 digital disc player for my own in house use at dealer cost. The Harman-Kardon people promised me a scrap T-60 tonearm so I could tear one apart and learn how to make the bearings work better. Acoustic Research promised me a sample AR turntable to evaluate. So far, no disc player, no tonearm, and no evaluation sample turntable, even with follow up letters to

each company. Why then did they make those promises to me?

“Superdisc” records are not exactly a new idea. Recently a new client brought in his collection of Audiophile records for my evaluation. This is the brand name of a set of incredible records produced in Saukville, Wisconsin. The good news is the dynamic range and natural musical balance are equal or better to the very best I have ever heard. The format is a bit strange – they are 78 r.p.m. records, but are microgroove (use a normal stylus, not the old and much larger 78 r.p.m. nail of a stylus). If you have thought that 45 r.p.m. direct discs were dynamic, you won’t believe the dynamics of a 78 r.p.m. superdisc. Most of the records (about 20 in the series) are Dixieland Jazz, records of some of the famous jazz groups of this area (Doc Evans of Mendota and others). I would like to see an Audiophile record of Saukville, Wisconsin sent to every recording studio in the U.S.A. along with a note telling the producers and engineers there to just try and equal the recording quality of these records. I bet 99% of all studios cannot do it. Now for the bad news – these stunning records were made about 1950! Yep, they are over 30 years old. Just imagine the desire and care Audiophile records had back then (swimming up stream against the mass produced crowd) making records of far better fidelity and dynamic range than was possible to play back on the “hi fi” equipment of that day (or of this day too for that matter). What has the record industry gained over the past 30 years? Not much, except for information density. We now pack more data in the same space, both on records and tapes (and on digital discs) but not necessarily higher quality data. Isn’t progress fun sometimes?

**Power, what is it? Lots of our callers do not seem to know so lets discuss it. The typical definition of amplifier power seems to be:**

A large number derived by the audio company’s advertising department for the purpose of making a good impression on a specification sheet and selling lots of trash.

In the early 1970’s, advertised power got so inflated (especially by the “brown box” all-in-one console makers) that units with tiny little radio amplifiers of less than 2-5 watts “actual” power were getting rated at “600 watts instantaneous peak power” or more. We got customer response then such as, “why should I buy that lousy little 70 watt Dyna St-70 when I can get a maggotbox with 800 watts?” Things got so bad (the industry just cannot seem to police itself) that the Federal Trade Commission finally stepped in and decreed a “government standard” power rating as follows:

“Thou shall advertise only that RMS power your trash can make after running at one-third power for an hour and then at full

power for five minutes and thou shall specify over what frequency range and at what THD rating you achieve this power. So there!”

Now that we have this dandy gummit regulation (one among billions and billions as a famous astronomer would say) all you consumers are “protected” from us nasty manufacturers who would try and fake a meaningless power rating past you, right? Wrong!

You still don’t know what “power” really means, let alone “RMS.”

You still don’t know the conditions of testing for power (or that manufacturers can still “cheat” on the tests, and still stay within FTC regulations).

You still don’t know how “power” relates to what you hear.

You still don’t know “how much power” you need or should have for adequate musical performance in your audio system.

Everyone still tries to sell you “watts” instead of lifelike audio performance. (Numbers are easier to sell than quality.)

You will still find salesmen trying to sell you “150 watt” loudspeakers and you can find no objective reality in that “number” at all or rational reasons why you should pay for it.

You still don’t know how to compare one power rating to another. The commercial press tells you all amps with similar specifications sound identical (and are essentially perfect). The underground press tells you that all engineering specifications are worthless and that two amps of the same “power rating” can seem to have, subjectively, much different power capabilities. Why?

Very, very, importantly, you still do not understand how power relates to the use of your volume control or what happens to power when you use equalizers, tone controls, or electronically boosted loudspeakers.

And finally, you still do not understand how power relates to how loudly your audio system will play (or even under what conditions “loud” is described or why something sounds more or less “loud”).

Helpful hint – power does not relate to loud on a linear basis – however, voltage output does – but what is voltage output? In trying to learn about audio, you are going to find, in general, learning the answer to one question leads to discovering there are now more new questions. However, that is part of the fun of it – at least for you.

Now lets see if we can find objective answers to some of these questions.

What does “RMS” mean? You always see those RMS power ratings, what’s this RMS guy, anyway? RMS stands for Root Mean Square (that is sure a lot of help, isn’t it). Uh, what does Root Mean Square mean? If you have a good working knowledge of integral calculus you probably know the answer. However, for the few of you that are a little rusty in that speciality, what we are talking about is a mathematical method of assigning a number to an arbitrary waveform so that the equivalent power of that particular wave form can be compared directly to the power of any other wave form. Anyway, Root means Square Root in this case, (yes there is a real use for that little “check” key on your calculator). Mean is a statistical term that is pretty close to, but not the same as “average” (average is determined by taking the sum of all of the samples and dividing by the number of samples – mean is determined by squaring each of the samples, adding the squares together, taking the square root of the whole mess, and then dividing by the number of samples). Square of course means the number times itself. This whole process is necessary to be able to compare the power of one kind of wave form to another.

In audio, we are, in general, talking about sine waves when measuring power so we won’t worry about other wave forms at this time (the other wave forms happen to be music, but oh well —). With a sine wave, the conversion to RMS is easy. One simply multiplies the peak (greatest) voltage by .707 to arrive at RMS voltage. Of course if the spec sheet says “peak to peak” then you have to first divide that number in half. So, for example, if that car radio power booster claims a 20 volt output,” to find out what that really means, divide by two (10) and multiply by .707 to get a true RMS voltage of about 7.07 volts.

Once we have found the equivalent RMS voltage of a wave form, we can then determine the power by squaring this result and dividing by the load resistance (in the case of the audio industry, the standard load used is 8 ohms). Note that many manufacturers misrepresent (lie about) their power rating by using a non-standard load (especially in the car radio business). For example, a little car radio with a 20 volt peak to peak capability would have just 7.07 volts RMS output, and that voltage, into a standard 8 ohm load, would be  $(7.07 \times 7.07) / 8 = 6+$  watts. However, if the manufacturer conveniently uses a 4 ohm load, the “power” will “double” to over 12 watts. And, if the manufacturer “forgets” to convert peak voltage to RMS voltage, the result will be 25 watts, and if he also forgets to convert peak to peak voltage to peak voltage the power will be  $20 \times 20 / 4 = 100$  watts! I hate to be the bearer of bad news, but there are a lot of you out there that

have paid for “100 watt” car radios and only have 6 watts! Remember, only home amplifiers have to conform to FTC standards, not car radios.

Thus, to simplify, we can say that “RMS Power” in audio terms, refers to the continuous mean power produced by a sine wave of some peak value into a standard 8 ohm load resistor. Furthermore, to give meaningful comparisons of even this simple specification, the manufacturer must, for home audio equipment, specify the frequency range over which the amplifier will make power, and at what distortion level. Note that car radio makers do not have to conform to FTC standards, nor do amplifiers for “professional” applications. Thus another way to “cheat” is to call your product a “professional amplifier” and then you can get a “power rating” high enough to satisfy the wildest dreams of your advertising department.

What are the test conditions of FTC “power” ratings? First, we should discuss how they were arrived at. Amplifiers produce heat. They are not 100% efficient and cannot convert all incoming energy into output power without internal losses. These losses are converted into heat, which the amplifier must dissipate adequately or it will overheat and fail. This is the reason for heavy heat sinks and heat fins on most high powered amplifiers, and for some protection circuits.

Obviously, heavy heat sinks and protection circuits cost money and if a manufacturer can “get by” without them, his profits will be higher. Thus, in the early 1970’s some companies were first cooling their amplifiers to a low temperature before making power tests, and running forced cold air across them during testing, so they could get more power on the bench without overheating the amp and burning it up. Unfortunately, they did not furnish freezer chests for the amps when they sold them, so the end user could never get the specified power without overheating and blowing up the amplifier. In addition, amplifiers can absorb some heat for a short period of time before overheating, even if heat sinks are skimpy. Thus many manufacturers would only run the unit at “full power” for as long as necessary to take an instrument reading (a few seconds at most). Of course at home you need the power all the time so again, amps made rated power at the factory but burned up in the user’s home. Finally, a charged up power supply takes a finite amount of time to discharge, and if the manufacturer made his power tests on a “pulse” basis – injecting only one cycle of signal, the amp would make much more power for an instant, before its feeble power supply fell apart. Of course, at home, you need the power you paid for longer than a nanosecond, and with an “instantaneous peak power” rating, you didn’t get it. Fraud was running ram-

part in the audio industry, and the FTC decided to do something about it.

They deemed that an amp should have to run at 1/3 power for an hour before testing (and at 70°F room temperature and without forced cooling unless the amp had a standard fan) to eliminate the “trick” of testing “frozen amplifiers.” The FTC (bureaucrats not engineers) picked 1/3 power assuming this was a nice easy test to warm the amp up to normal operating conditions (they were wrong – more about this later). After “warm up” (FTC called it “pre-conditioning”) the unit had to run at full power for 5 minutes, thus eliminating fake power supplies, inadequate heat sinks, and inadequate thermal protection (so they assumed – wrong again). Distortion had to be specified so you could recognize the difference between 100 watts at .1% distortion and 100 watts at 10% distortion, for example, as the FTC assumed simple distortion was important (it is, but again, not all of the story). In addition, because it is much easier to make 100 watts at 1000 cycles than it is at 20 cycles (much harder power supply test) or at 20,000 cycles (much harder thermal test) frequency at which power was available had to be specified to eliminate another source of “hedging” (again, assuming that flat 20 to 20,000 Hz response is important, which again, is not necessarily a good assumption).

The FTC assumed these “consumer protection” regulations would clear the air, and provide better and more durable audio amplifiers for the consumer. They were partially right as the worst fraud (primarily stereo console radios) was eliminated. However, some clever designers found new ways to cheat, and of course with “professional” and “automobile” amplifiers (which fell through the cracks of the regulations) the same old fake ratings still abound.

Several interesting things happened right after the new FTC power regulations went into effect.

1. All of the Japanese manufacturers came out with “all new models.” A face saving maneuver to avoid having to show a lower power rating than what had been previously advertised for that model – a new faceplate and a XZY-2000 model at 30 watts is not as embarrassing as dropping the power of your YZX-5000 model from 150 watts to 30 watts. Of course the insides remained the same
2. Some high powered amplifiers were made less reliable. For example, one U.S. made 150 watt per channel amplifier that was noted for durability would not get through the one hour “pre-conditioning” tests without its internal overheat protection sensors activating and shutting the amplifier off. It had the thermal sensors

located directly on its output transistors for the quickest possible response to any overheat problems, and in normal use never overheated as it was a good design for that era. The “engineering” cure for the shut off during testing was simple – the company relocated the thermal sensors far out on the heat sinks – away from the output transistors they were supposed to protect – thus making them much slower to react to any overheat problem. The amp would then get thru FTC pre-conditioning without shutting down, but the end user got a less reliable product, as in use now the output transistors could overheat and fail before the thermal sensors would shut off the amp and protect it. You see, the regulation did not specify that the amplifier had to operate at a safe temperature during testing, only that it lasted for that one hour, once, before blowing up. Sorry folks, gummit regulations do not replace good engineering, and do not set minimum standards, but only set maximum standards, as after a standard is set, everyone designs (in all fields of endeavor) only to meet the minimum requirements of the standard as there is no “marketing” value in overdesigning, as if the gummit says this is the standard, and you meet that standard, it must be good enough, right? Sure.

3. Most remaining vacuum tube amplifiers had their power ratings reduced. Although, at the time, vacuum tubes amplifiers were assumed to be much more rugged and durable than the flaky transistor amps, and people thought vacuum tube amps were “more powerful sounding,” in fact, during pre-conditions, the output and power transformers of vacuum tube amplifiers heated up more than normal, becoming more resistive, and causing the output power to drop. Thus even the old solid, durable, and powerful (for that day) Dynaco St-70 (35 watts per channel) had to be derated to 20 watts per channel. Although it would make its original advertised power for several minutes (better and more honest a rating than almost all competition) it would not make full power after running at 1/3 power for an hour. Because it was not cost effective to do a faceplate redesign as the “off-shore” manufacturers were scurrying to do, Dyna did the honest thing and published a new, and lower power rating, along with an objective explanation why, and everyone else laughed at their honesty. (It was not cost effective to design a new vacuum tube amplifier in the mid 1970’s as Dyna could already see the handwriting on the wall for vacuum tubes).

4. Only one audio amplifier (to the best of my knowledge) that was designed before the FTC power testing rule was proposed passed the complete test with flying colors – the Dyna St-400 made its complete 200 watts per channel with no fudging, no fan, and no derating. It was the most honest amplifier of its day.

The major problem with the 1/3 power for an hour test was that it was not an “easy warm-up” as the FTC bureaucrats assumed, but a nearly worst case test, causing much greater stress than full power operation. Nobody realized this (except Dynaco) before the rule was passed, and afterwards, the fit hit the shan. (To be continued).

*Frank Van Alstine*

### VOLUME THREE NUMBER FIVE MAY, 1984

Stop! Quit sending in questionnaires! We are buried in them! Will take another month to make sense out of all the data but hope to publish some rational results in June or July. Thank you for your cooperation!

Karl Nehring writes to question my anti-magic-capacitor attitude. He points out that Walt Jung did have a large write up in *Audio* magazine some time ago giving distortion data on capacitors and discussing many aspects of capacitors that appeared to be meaningful. A good question!

First of all, Jung basically “proved” that polarized capacitors break down and distort when reversed biased (a fact well know among electrical engineers for the past 40 years). A “worst case” example of this is putting in a power supply capacitor backwards and putting say, – 50 volts to the + lead of the supply capacitor. BANG! It will likely “blow up” just like a little firecracker! This is indeed distortion! His tests showed that the less reverse voltage you apply to a polarized capacitor, the less it breaks down and distorts. No kidding! Kind of like writing a research paper showing that if you curve a plane in a certain way, you can get more airflow across one side than the other and produce lift! Obviously (to good engineers) one does not use a polarized capacitor in a centerline coupling application where the AC signal swing will go both + and - as the capacitor will be reversed biased half the time, will distort, and will not “sound good.” Does this make the capacitor bad? Of course not, it only tells you what was already known (to everyone but the editors of *Audio*), that there are proper, and improper applications for various kinds of capacitors. Jung then continued to explain that you can kind of “make” a non-polarized capacitor by putting two standard polarized capacitors “back to back” – you cannot – you will actually cause both to break down. There is a solution – not difficult to come up with – use

non-polarized capacitors in this type of application. No magic, just common sense.

Jung then continued by discussing Dielectric Adsorption and pointing out this was a source of distortion in capacitors and that some types of capacitors have less dielectric adsorption than other types. True! Jung failed to point out that this is a low frequency effect. Jung also failed to mention that in a properly designed circuit the coupling capacitors do not change state. (There will be no signal charging or discharging the capacitor – it will simply pass the signal much as a two man push-pull timber saw passes the energy of the man on each end and cuts down the tree without the saw bending at all.) If the “saw bends” it is being used improperly – if the capacitor is in a charge-discharge mode it is a bad circuit design and any sonic ill effects are the responsibility of the circuit designer, not the capacitor designer. Of course the capacitors will “charge” when you turn the unit on, and “discharge” when you turn it off – and it might take a couple of seconds to form the capacitors completely, but while playing music they do not change state at all in a competent circuit. (It is much more likely that you have an incompetent circuit than incompetent capacitors.)

Finally, Jung, after “proving” that some kinds of capacitors “sound bad” (there was no correlation between his “testing” mentioned above and the “sound” of any kind of capacitor properly used) then proceeded to replace all of the “bad sounding” capacitors in a Dyna PAS with “good sounding” capacitors and claimed the results were just wonderful. He did not document whether any of the original capacitors were defective, whether or not he made any changes in real value in replacing capacitors (a capacitor is the value it is – not the value printed on it). In fact, he made no objective documented experiments at all – just jumped into the “magic capacitors sound just wonderful” mode like all the other snake oil salesmen.

Finally, Jung pointed out that capacitors have stray inductances. True! He suggested “bypassing” large inductive capacitors with smaller less-inductive capacitors to “cancel the inductance and get better sound.” Wrong! All capacitors are inductive unless their physical size is smaller than this (.). The frequency at which inductive resonances occur are dependent upon the size, value, type, lead length, body and dielectric materials, and so on. In general, the inductive resonances occur at higher frequencies in smaller capacitors. It is, at this point, nearly impossible to document objectively the various inductive resonances caused by any given capacitor using available standard engineering practices. Bypassing a capacitor will simply add the resonances of the new capacitor in parallel with the resonances of the old capacitor which may cancel, add, form new multiple resonances, or whatever. It

may make the situation better, it may make it worse. You cannot document what it will actually do. It is, at best, engineering by guessing. Since all that one knows is that you are absolutely adding more resonances by bypassing, and since one can reason that what we want is no spurious resonances at all, one can then logically suggest that paralleling bypass capacitors and adding unknown resonances is not a clever way to get less resonances. It is a clever way to sell you lots of expensive capacitors!

We would like to find out exactly what capacitors are doing. We just spent \$35,000.00 to enable us to find out! Stay tuned!

Thus Karl, Walt Jung did have a lot to say, but it covered no new ground, and leaped from fact to fiction. It did sell a lot of capacitors.

The nice folks at Pacific Northwest Audio Society slightly misunderstood a couple of notes in my last *Audio Basics*. They printed that we “like” or “recommend” Corning resistors and Panasonic capacitors. Wrong – I simply gave a couple of sources for parts that we know do work reliably. We really do not care what brand of parts you use as long as they are appropriate for the application and are reliable. I “like” Motorola transistors “better” than Fairchild, for example, only because we get a better yield on the average with Motorola and they provide better pricing and shorter lead times (sounds better is not a criteria – until you can define “sounds better” for me in objective terms).

We recently got a copy of a rather bizarre article written by the editor of *Fanfare* (an underground record review magazine). The article was a one page diatribe condemning Cramolin as “sounding bad” and “ruining equipment and expensive magic cables.” First of all, you cannot ruin magic cables – unless you really believe that one kind of magic is better than another kind B.S. but I thought that went out with the witch burning trials long ago. We find that Cramolin only “sounds bad” if you think the sound of intermittent and noisy controls and switches and oxidized connectors “sounds good.” If you really like the sound of old oxidized controls, I have a real deal for you. I’ve got boxes of old discarded Dyna controls guaranteed to be noisy, corroded, oxidized, intermittent, and free of Cramolin, for only \$25.00 each (what a buy I have for you *Fanfare*!). For those of you with real Cramolin concerns, we will, on special order, not clean your controls, jacks, and switches when we rebuild your equipment for the special price of only \$75.00 per not cleaning. We value the anti-Cramolin lunatic fringe business too, especially if we can make a killing at it (everyone else does).

We spotted one strange letter to the editor in the most recent *Sensible Sound*. The gentleman claimed to have talked to me once by phone “several years ago” and decided I was a “flake” based upon his remembrance of that one single phone call years before. He then proceeded to condemn *Sensible Sound* for reviewing any of our products. Gee - I wonder what I said? *Sensible Sound* responded by mentioning they get lots of letters about us, both pro and con. (They never told us that or forwarded any complaints to US). Anyway, we don't mind the “pros” but we cannot do anything about the “cons” unless you tell us what you think we have done that you don't like. Complaining to somebody else will not help fix your problem unless complaints are then brought to our attention too. We cannot take action if we don't know that you have a problem! Sure, you have every right to contact someone like *Sensible Sound* if you feel we have wronged you. But please give us a copy of your letter too. We cannot fix it if we don't know it is broken! If you don't want the problem fixed, if you just want to tell people we are rotten bastards or whatever, then obviously don't contact us – we don't like “hate” mail any better than anyone else.

Product review. The new bottom of the line Harman-Kardon T-25 (available for about \$150 at discount stores) is a winner. The arm is different from the higher priced models (which are all quite good) in that it has a simpler, less expensive, and better arm (at least we can get into both the vertical and horizontal bearings with liquid silicon while on the more expensive models, we cannot lubricate the vertical arm bearings). Here I have to lamely go back to a subjective evaluation, but, in my opinion, for what it is worth, the T-25 seems to play noticeably cleaner deep bass than any other arm I can remember in recent years (after a bit of liquid silicon treatment that is). I like it enough that I bought one for my own system. Its only real problem seems to be a bit of low level hum from the internal power supply transformer for the DC servo-drive motor. Dave can make the trip link absolutely friction free, and the T-25 is one of those rare units that makes my system sound better, not just different. It shuts off at the record end too!

We have a “fix” for the residual hum in the T-25, and at the same time have made it even more stable and better sounding. We have designed an outboard power supply box for the unit (similar to that of the late lamented Connoisseur BD103 turntable – but better). We remove the power transformer and raw power supply card from the T-25 chassis, increase the power supply times thirty-three (300  $\mu$ F to 10,000  $\mu$ F) which decreases the ripple on the 12 volt DC supply from nearly 1 volt to less than 40 millivolts (33 times less), improves the speed stability by the same factor (and it was

good in the first place), and makes it start nearly as fast as a direct drive unit. AC hum is simply gone! There are no AC fields inside the turntable at all. The revised T-25 is quiet! The external power supply box contains the power transformer, power supply parts, AC line cord, AC power switch and indicator lamp, and a RCA phono jack which is the 12 volt DC power supply feed for the turntable. The supply box also contains a fuse for the system, an item Harman-Kardon did not originally supply. The turntable itself has a shielded DC supply cord which plugs into the power supply box, rather than the original AC power cord. No AC current, no AC hum fields, and thus no hum at all, its that simple. We have this revised unit available, with our external power supply, silicon lubricated bearings and linkages, and with our Longhorn Grado cartridge installed, for \$325.00 complete, including delivery in the continental U.S.A. If you supply a new H-K T-25, we will convert it (including the Longhorn Grado) for \$175.00. Sorry, we don't work on used units as we cannot account for possible previous damage or missing parts.

Now back to amplifier power (continued from last month).

We ended by mentioning that the FTC bureaucrats assumed that one-third power operation would be a nice easy test for an amplifier, simply warming it up a bit to defeat the “frozen amplifier” fake power testers. Were they ever wrong! One-third power operation heats an amplifier up much more than operating at full power. Why? Essentially, because at full power the amplifier is efficient, and nearly all of its energy is dumped into the load (the speaker or test load gets hot, not the amplifier). Of course at very low power, nothing is stressed, and the amplifier does not overheat. But, at third power, most of the energy is dumped into the amplifier's heat sinks and not much goes to the load. The amplifier is forced to dissipate most of its own energy internally, while the load is not heated as much. Thus, the simple “warm-up” test required by government standards was a worse test than the full power end result requirements.

What can a manufacturer do about this? How can he make the amplifier design “strong enough” to absorb more than “full power” heating? How can he “make it through” the FTC preconditioning tests without overheating and shutting off the amplifier? There are lots of ways to do this, some honest, and some simply finding new ways to drop through loopholes in the rules and fake the power rating as bad as ever.

The expensive way (and reliable way and the way that provides you with an amplifier that really makes the power it claims under a wide variety of conditions) is to “bite the bullet” and build an amplifier with big heatsinks that can

safely dissipate lots of heat long term without overheating any internal parts under any conditions. Unfortunately, this requires integrity by the designer – he has to want to build an amplifier that works well more than he wants to build one that sells well. Lets look at some of the many ways to cheat.

We already mentioned the ploy of moving thermal shutdown devices far away from the heat source (the output devices) so they don't shut down as soon, thus passing the FTC preconditioning test, but providing less reliable protection for the consumer.

Many receiver manufacturers quickly realized that the FTC did not specify how hot the amplifier could get during testing. Thus, by eliminating thermal protection completely, they could let their units get blazing hot during testing, and as long as one sample (not all production units are tested or they wouldn't have many sellable pieces) made it through the test without melting, they could still claim higher power, even if the sample was so badly stressed by the test it was on the verge of failure and its reliability ruined.

Other manufacturers realized that the “one hour of pre-conditioning” did not specify one continuous hour and could with some strain of logic, be interpreted as a “sum total of one hour of pre-conditioning time.” Their answer to inadequate heat sinks was simple – thermal breakers that reset automatically after the amp cools off. In testing, the amp gets “red hot” and shuts off. After a while it cools off and turns back on, heats quickly up again and again shuts off. It might take a couple of weeks to accumulate a total of one hour of “on time” between overload and shut down cycles, but is was technically within the rules.

Of course this kind of amplifier won't make power in your home system as it will heat up and shut off there too. And while the manufacturer didn't care if it took a month of waiting to accumulate a total of one hour of play time, I expect you might object to taking a month to play all of a record while the amp cycles on and off.

Another ploy was based upon the knowledge that an amplifier does not put out much heat at full power. Several “off shore” manufacturers used this fact to design receivers containing two amplifier stages. The first amplifier (a very small one) was designed to conveniently make its full output power at (you guessed it) exactly one-third of the overall power rating of the unit. The second, crude and larger amplifier only “cut in” at over one-third power. During testing, the small amp runs at full power for an hour, putting out very little heat. Then for full power testing, the large amp cuts in (cool and not yet turned on) for the last five minutes before blowing up. Neither amp really goes through the pre-conditioning cycle as

intended, and of course, in your home system you don't run at exactly one third power or at exactly full power and you get to hear the distortion of the two amplifier sections attempting to work together. Why do it this way? Because it costs less to build two crude amplifiers than to build one good heat sink, that is why. The manufacturers "invent" new amplifier classes for these products, Class X or Y or whatever. We call it Class Fake.

Another end run around the rules involves the use of a variable voltage power supply. In this case, the amplifier is run at low voltage under low power conditions (such as preconditioning testing) and runs cool. Under high power demands, the power supply voltage is pushed way up for the short periods of time necessary to make the power rating. Again, this method eliminates the need for heavy, expensive heat sinks, power transformers, and rugged output devices. However, because the output circuits have little heat sink capability and are really not rated for continuous full power operation, lots of electronic protection circuits have to be designed into the amplifier to keep it from blowing up in home use. These circuits are usually cutting in, degrading the sound, and under demanding use conditions, this kind of design tends to shut off completely, protecting itself, but not providing you the high power you thought you paid for at such a low price. There is no such thing as a free lunch. Protection circuits cost less than quality hardware and there is no adequate substitute for real watts. This type of design might work, however, if there was some good way to "sense" the power supply demands in advance, so that the supply voltage could be increased just before the demands were needed. However, we have no time machine circuits, and the power supply is driven by the same signal feeding the audio circuits, takes a real amount of time to change state, and thus supplies more voltage just after it is needed. Thus the rate of change of the power supply is added to the rate of change of the audio circuits, causing both power supply slewing and current limiting under transient conditions (and music is all transient conditions). The supply may be "fast enough" for a test sine wave but that is not what it has to play in your home with a music signal. It would be possible to make the concept work using a high quality digital delay line, first feeding the power supply, and then the audio circuits after an adequate time delay to give the supply a "head start." The catch is the cost of a quality digital time delay would be more than the cost of a more conventional and real power amplifier in the first place thus negating any weight, space, or cost savings in the amplifier.

Another common trick is to rate the power into some other load than the specified 8 ohms. For example, if the amplifier has adequate internal current capability and thermal dissipation ca-

pability, it should make twice as much power into 4 ohms as into 8 ohms simply because power is defined as voltage squared divided by load resistance, and all other things being equal,  $V^2/4 = 2(V^2/8)$ . 100 watts is "better" than 50 watts isn't it? Not when the first rating is into 4 ohms and the second is into 8 ohms, then the ratings are the same thing. Of course all things are not equal and many amplifiers overheat more and are less reliable into 4 ohm loads as the current flow thru the output devices doubles into 4 ohms and most amplifier don't have that capability built into their power supplies.

The real problem here is that people have come to expect "power rating" to be some kind of reliable standard. Just as everybody "knows" (in the U.S.A. at least) what "10 feet" means and "feet" has come to be a reasonably reliable standard for a unit of measurement, hi-fi buyers have come to expect that "watts" have a similar standard meaning they can relate to and have the right to expect that 100 watts means 100 watts. Unfortunately, with watts, we have a variable length ruler, crunched at will by the manufacturer to get the biggest measurement possible for his merchandise. So Joe Average thinks that a 100 watt rated car radio is worth real money, when all he really gets is 6 watts that can be cobbled up out of any cheap audio power IC. Now Joe would be really unhappy if the twenty foot ladder he just bought didn't reach to the 10 foot eaves on his roof, because the ladder manufacturer had redefined the "foot" to mean the length of his baby daughter's foot. However, when Joe hears from us that his car radio manufacturer has just done the same thing, does he get mad at being defrauded by the car trash builder – oh no no no – he gets mad at us for giving him the bad news and defends the validity of his purchase and the good sound and the wonderful 4 ohm watts he just bought. Tough luck Joe – your ladder is still too short!

Of course the rationalization given by everyone for all of the above fraudulent practices is that, "the customer doesn't really need all that power on a continuous basis – he just needs lots of power for the loud peaks in the music – so all these loophole design amplifiers are really just fine and it is really nice that Joe Average can buy a 5 pound "200 watt" amplifier for \$79.00 – and since those car radio speakers are mostly 4 ohm speakers, what is wrong with advertising car radio watts into a 4 ohm load?" What is wrong with me taking your money for an *Audio Basics* subscription and not delivering you any issues at all? You don't really need it! What is wrong with delivering a product that doesn't make its claimed performance, that doesn't make the spirit of the specifications, that measures "baby foot watts"? It is fraud, that is what is wrong! It is wrong, immoral, theft. Why does the industry sanction it and why do you put up with it?

O.K. We shall now assume a miracle has occurred and everybody is now finally rating their power exactly in accordance with the intent of the FTC standards, giving power ratings referenced to 8 ohms, and building amplifiers sturdy enough that they will actually make their advertised power ratings on a sustained basis without stress or overheating. Now things are just wonderful and you now have a "watts" standard that is useful and meaningful, right? Wrong! One company's "watt" still cannot be directly compared to another company's "watt." Joe Average can now be sure his 20 foot long ladder he just bought is long enough to reach his roof, but he still cannot be sure the sucker is strong enough to safely hold him up!

The ladder "foot" specification doesn't tell you how strong the ladder is! The FTC "watt" specification doesn't tell you how strong those watts are. You need to know more about the nature of the watts and how they relate to your use conditions.

The FTC specifies that a manufacturer shall rate his power delivered into an 8 ohm load resistor. Although this is a "starting place" for a universal standard, unfortunately, loudspeakers are not equivalent loads to 8 ohm resistors, and every different loudspeaker represents a different, and almost always, a much more difficult load than the standard test resistor.

A resistor is a nice guy, predictable, passive, only providing a nice uniform resistance to current flow. Use an amplifier to force current thru it and it just sits there getting warm as the amplifier power is gently and uniformly changed into heat dissipated by the resistor. At any audio frequency the resistor is the same nice passive load and it is the easiest possible load that amplifier will ever see.

The loudspeaker system is not as nice. It is a complex circuit composed of essentially three kinds of electrical components. The first is the resistor (primarily the DC resistance of the voice coils and the resistance of any simple resistors in the crossover network – which are, by the way, not usually all that simple as for high power dissipation it is usually necessary to use wirewound resistors which are not simple loads, but have substantial inductive components too). The second component of the loudspeaker load is the inductance of all of the coils in the system – the loudspeaker voice coils, the crossover coils and or transformers, the coils in the wirewound resistors, and the stray inductance of all the lengths of wire in the system – yes Virginia, there really are wires with inductance – namely all of them). The third component is capacitance, the capacitance of all the crossover capacitors (even in Magneplanars) and the stray capacitance of the coils and wiring (you got two conductors near each other? – congratulations – you have got a capacitor).

An inductor is a clever device that opposes the flow of AC current at high frequencies and passes AC current at low frequencies. A capacitor does the opposite – passes high frequency AC current but opposes low frequencies (blocking DC completely with any luck). Thus, with clever use of appropriate capacitors and inductors, it is possible to send the “right part” of the audio signal to the appropriate speakers – highs to the tweeters – bass to the woofers and so on. Simple? Nope! The capacitors and inductors have another effect. They are, depending on their circuit application, springs! You stuff energy into one and it spits it right back at you a little bit later. If you have several inductive and capacitive components in a loudspeaker system (and you do) then all these springs interact providing a real “interesting” ride – much like driving an old Buick with no shocks down a bumpy road. Or consider that it is a bit easier to “push” against a wall safe than it is to “push” against an operating pneumatic jack hammer. Guess what! Amplifiers do not like to work into multi-resonant loads that spit back and fight against them. Amplifiers do not, in general, produce the same power under these conditions as they do in tests. Some designs work better than others under real world conditions. All watts are not the same. (To be continued).

*Frank Van Alstine*

### VOLUME THREE NUMBER SIX JUNE, 1984

Dave Umeda and I have spent lots of time this month going through the equipment survey. Tabulating the results and getting the data into a useful form to report back to you is taking a lot more time and effort than I had expected. We have raw data compiled for about 100 responses so far, with about another 50 to go. We do not have exact numbers and percentages assigned yet, but several very obvious trends are becoming apparent, so I shall give you some preliminary results this month that I think will be interesting and useful to you.

First of all, it is obvious from the careful and detailed way the vast majority of you filled in the survey form that *Audio Basics* readers are an “elite” group of intelligent, thoughtful, and caring people. Most of your responses went into great and careful detail about the equipment, using extra pages to give us very complete data. Great care was taken to give us legible and thoughtful responses. You put a lot of time and care into responding to the survey and we really appreciate that. I can contrast the quality of your responses to the quality of the average letter we get from the general public asking for initial data about our products (responding to our *Audio* and *Stereo Review* classified ads). Over half of our initial information requests exhibit penmanship, spelling, and “crayon” writing quality that would indicate the individual flunked kindergarten. People write on scraps, forget to give us an

address, ask only about Jensen Car Speakers, want price quotes on equipment it is obvious we do not sell, ask only what is better - Threshold or Audio Research, ask for us to recommend some “good” equipment (not ours as everybody knows Dyna cannot be any good), and in general make fools out of themselves. I have found this trend to be rather appalling, for obviously we deal with a highly “culled” group of those that respond to our ads at all! We are not going to get inquiries from those that cannot read, write, have no interest in good audio equipment at all, or do not have enough curiosity to inquire to a little mail order engineering shop in Minnesota - exploring all their options to better their audio system. I have become very concerned over the past few years about the education system in the U.S.A. as reflected in the poor average quality of our initial responses. People should come out of school knowing how to write a letter. It is very reassuring to read your survey responses and find that at least our readers still do.

We can, however, see in the results a few “red flags.” In general, we can separate you into two different categories of equipment owners. There are a substantial number who have owned very few pieces of equipment over the years (and most of our respondents have been in audio for a long time). These people have tended to have carefully purchased very good and durable equipment the first time (such as original Dyna equipment along with AR speakers and turntable) and have used and enjoyed it for over ten years without spending another penny. These people have tended to substantially upgrade their systems recently (many with our circuits installed in their original Dyna chassis) and we expect they will go another ten years without neurosizing about newer equipment. This group of people really get their money’s worth!

Another large group of you are, however, equipment collectors. You have owned every little change or minor engineering improvement that has come along. Indeed, many of you still have all your past equipment, basements and closets full. Some of you have three or four “ho hum” systems - one in each room in the house. I need to caution you that quantity does not make up for quality. I also may be able to provide a service for some of you.

It seems like many of my readers ask where they can get old Dyna units for us to rebuild. It also appears that many *Audio Basics* readers have closets full of old, unused Dynaco equipment! It appears that it would be a good idea for us to be able to put those of you with excess equipment in touch with those looking to buy this equipment. I would not mind devoting a little space in *Audio Basics* listing names and phone numbers of those of you who want to buy or sell Dyna or Hafler units that we work on. We will not attempt to duplicate the general buy – sell services of *Audiomart*, just attempt to act as an information exchange service for our readers for the equip-

ment we specialize in. Thus, if you are looking to buy or sell Dyna or Hafler units, drop us a card and tell us what you want to buy or sell, and give a phone number where you can be reached. We will print a listing. Obviously, we cannot guarantee the service nor the equipment. We also request that equipment not be “drop shipped” directly to us for rebuild until you have first examined it and are satisfied with its condition. We cannot be a “middleman” regarding disputes about any problems with equipment purchased from others.

I will temper my remarks about the “equipment collectors” by noting that you are not, in general, collectors of outrageously expensive esoteric equipment, leaping from Electro-Research to Conrad Johnson to Pink Triangle. Your collections are more rationally priced and useful than that. You have simply spent too much money taking steps sideways. I will cover this in more detail when we have a tabulated equipment listing finished.

Troublesome components show strong (and expected) trends. You have lots of problems with vacuum tube power amplifiers – they seem to be the least reliable of any components and many of you have given up trying to keep them running, even expensive and recent ARC and C-J units. (We told you so!) Tape recorders are another strong problem area. They wear out fast, have lots of problems, and are expensive and difficult to fix. You have thrown away many of them (which is why we recommend the \$60.00 Sharp RT-100 – it works as well as most and only costs \$60.00 to throw away). You gave lots of reports of troublesome “off-shore” receivers - especially troubles in getting them fixed reliably and lots of out of the box new defective units. In particular, Sherwood, was mentioned an unusually high number of times as having receivers and tuners that wouldn’t work and didn’t ever get fixed properly. Many have had problems with the original Dyna St-120 which may be one reason we see so many of them for our new mos-fet circuits.

Records seem to be another problem area. You cannot keep them clean and free of ticks and pops. You don’t like the poor recording quality of many. They may be the most troublesome “component” of all. Along with this, you don’t like the hassle of keeping a turntable working properly, and need better advice and knowledge of how to set. up and adjust the turntable – arm – cartridge combination for good results. Finally, your listening room is a troublesome component. You need help in getting it to sound better and not get in the way of the music.

Another trend we notice is that lots of you do indeed take our advice given in *Audio Basics* and are happy after making use of it. You have, in general, made Longhorn stabilizer bars for your phono cartridges per our April, 1982, issue (many brands and types) and are very pleased and sur-

prised with the sonic results. The Longhorn stabilizer does seem to help most cartridges and if you have not tried it, we again urge you to do so. Many of you have damped your loudspeaker systems per our advice and you universally like the results. You have damped everything from LS3/5A's to Magnepans, and one of you has even used Plast-i-clay on his clock radio! We see a trend in keeping subscribers who try what we suggest, and losing after one year those who tell us our ideas cannot be any good (of course without trying them).

Many of you have "homebuilt" loudspeaker systems of all shapes, sizes, and varieties, many built along the lines of Speaker Builder or Speakerlab. We must note, however, that many more of you have "given up" on home made loudspeakers and have gone to one of the few competently engineered loudspeaker brands. Regarding loudspeakers, we do see a strong trend on good judgment on your part. When you have changed loudspeakers you show a very strong trend on changing to a really better system, not a great leap sideways or backwards to something worse or just different. Some of you, however, from the listing of speakers you have owned and now own, have never been exposed to a competent loudspeaker. We urge you to get out there and listen to quality loudspeakers and go beyond the mundane offerings of your local mass-merchandise discount store.

It is amazing how many of you have gotten rid of a Shure cartridge. Everybody in the world must buy at least one and some several. They seem to be the Burger King of phono cartridges.

We see a trend away from receivers on your part (that is where most of you started) and towards separate components of higher quality. However, you do not exhibit the same capability to proceed to "better" in choosing your electronics as you do with loudspeaker systems. Here we see many expensive steps sideways and far too many steps backwards in your choice of electronics. We see far too much use of "signal processing" equipment – those electronic "add-ons" that are sold on the basis of after the fact doing something to the audio signal to make it "better." They don't. They only make the signal different, and always worse. Those of you with simple, high quality systems in which each component from the phono cartridge to the loudspeakers works very well indeed seem to be the happiest with your equipment and tend to spend less money for your music enjoyment.

The trend in tape recorders isn't (except that almost all of you own one – and many more than one) but the trend in tape is a stampede. Maxell, TDK, and BASF in a distant third place take care of almost all your tape purchases. Based on our survey, I cannot see how any other company can stay in business trying to sell audio tape against these three brands.

Dream system responses show lots of imagination. Several of you want an all electronic system with your source material stored in large ROM chips – or better yet – a phone link to a master library where the world's reservoir of musical performance is stored on computer tapes and you can simply dial up the performance you want – load it into your computer controlled System – and play it. I hate to tell you this, but with the current state of the art in data transfer rates through phone lines, and given about 5,000,000,000 bits of information on a single compact digital disc, you are going to make the phone company very unhappy (at current local rates) or very rich (if rates are adjusted accordingly) as you will need about four days of modem time to transfer even a single record into your system and you are going to need an awfully big hard disc (600 megabytes) to hold the data. Perhaps someday!

Along these lines I should mention that a new company appeared on the scene at the C.E.S. show this June, claiming to have a digital record and playback system using high density floppy discs. Given the current state of the art in storing data reliably, they are going to have to compress the data at least 600 times as great as it is now stored on a digital compact disc and they better not lose any compressed data at all or there will be awfully big errors. I am not going to hold my breath until this system is working well in consumer's hands.

Lots of you (an unusually high percentage) would like our Transcendence electronics and B&W 801 loudspeakers in your dream system. Thank you! We are pleased you trust our judgement about high quality sound systems. However, your "dreams" are a bit obsolete now regarding B&W loudspeakers. It seems B&W has just released the new 808 system, which is, in effect like having four 801s per channel! They are only \$7,500 per pair (\$9,500 per pair in rosewood). I am told that they play a grand piano like a real grand piano and will make in excess of 120 dB cleanly. They are also about 6 dB more efficient than the 801 (which remains in production of course).

You also "dream" about having a good sound room (very good dream!). I am surprised (and pleased) to note how many of you recognize that the sound room is a very important component in your audio system and that you cannot get good sound in a hard, boxy sounding room, and that good music reproduction demands a room acoustically designed for that purpose.

Some of you are thinking about having a combined high resolution video system along with stereo sound of lifelike quality. Sorry, this isn't in the works for a long time. [1990 Note: We actually have stereo broadcast TV now, but only with mid-fi sound quality, not high fidelity. We do have great hi-fi sound on digital encoded satellite transmitted TV and a better picture than you get

with rental video tapes, but that is a story for a future issue]. Each television broadcast channel has an assigned bandwidth and only a finite amount of data can be transmitted. This bandwidth is inadequate now for quality color, black and white, and mono sound (although most TV receivers don't even use all of the data transmitted) and a stereo sound system will have to come out of the total information envelope somewhere, at the expense of poorer performance in some other aspect of the broadcast. You may get stereo TV sound soon, but you will not get high fidelity sound. Note too that "component" receivers are in general just the various bits and parts of a normal TV set repackaged into separate boxes to sell at higher prices. The whole marketing idea behind "component TV" and stereo sound TV is to sell you another high priced TV set – and then to sell you more cheap loudspeakers and another audio amplifier.

Caution is called for in using normal loudspeakers with a stereo sound TV system. Almost all loudspeakers have substantial magnetic fields, which can, if the system is placed near a TV set, distort the TV picture, and in a worse case, permanently damage the TV picture tube! There are now a few special purpose loudspeakers becoming available that do not have stray external magnetic fields. We should call your attention to two more new B&W models, the VM1 (similar to the DM110) and the VM2 (similar to the DM220) at \$149 and \$249 each. These are finished in either black or silver-grey (matching Sony Profeel finish) and are purpose designed for safe use in a TV audio application.

I am a bit disappointed with some of your requests regarding topics we should cover in *Audio Basics* in the future. There are far too many requests regarding topics we have already covered in detail, such as loudspeaker designs. Go back and read your back issues of *Audio Basics* and you will be surprised to find how much information is covered already. If you are a new subscriber, remember that all of our back issues are still in print and available at \$15.00 per year.

There are many thoughtful requests to cover topics that can stand some careful consideration and you can be sure we will take note and do it in the future. Some of the commonly requested topics are:

FM Antennas and how to get better FM reception.

Record care. What cleaners work, how to clean records, etc.

More help on sound room acoustics and treatment.

How to Set up a turntable and get the cartridge aligned properly.

Accessories. What record clamps, platter pads, turntable isolation bases, speaker

cables, interconnect cables, etc. are worthwhile.

More equipment reviews. Please understand that I am limited to equipment I purchase on the open market. I do not want equipment donated for review or lent to me by a manufacturer.

A discussion of our design concepts. Have patience! We have to finish discussing what the major problems are before we can start describing how to design them out. Note that we certainly do not even know what and where all the major problems are, yet. However, we are beginning to get some very interesting results with our computer assisted design and circuit analysis programs.

You want me to keep up with CD players too and let you know what and when to buy. You also wonder if we will be able to improve them so they work better. I should comment that I as yet do not own or use a CD player and am still patiently waiting for a RFI shielded unit at low cost with good error correction performance and good durability. I have not found it yet but can note that the Technics SP-7 is now down to \$350.00 in the Stereo Discount World catalogue and many discount stores have the Magnavox unit at less than \$400.00.

Can we make a disc player work better? Probably. I can note that in all FM tuners we have evaluated the FM multiplex filters ring just like the filters in CD players and essentially serve the same purpose. The FM multiplex section is nothing more than a 38 kHz digital sampling circuit and high frequency trash has to be removed from the audio signal there too. Our tuner (Super Tuner Two) has Mplx filters that do not ring! It is possible to build steep filters that have properly damped non-resonant response. I suspect the same engineering techniques would work well in the typical Digital Disc player. However, it is not worth our efforts to investigate this possibility until the market has settled down and reasonable standard models are available with a reasonably stable market life. We cannot make money designing new filters for a unit that will vanish from the market in six months.

I will finish this issue with an equipment review (not enough room for more discussion of amplifier power and distortion as we are including our latest catalogue this month too).

We just received another brand new B&W loudspeaker model, the DM330. It was introduced at the June 1984, C.E.S. show (along with the 808 and the VM1 and VM2). This speaker has had a new computer optimized enclosure design with internal bracing that reduces cabinet resonances to a very low level in a very cost effective way.

This is a three way system, kind of a big brother to the DM220 using the same polyamide tweeter and two 200mm composite short fibre cone

midrange/woofers with high temperature voice coils. The finish is simulated walnut (and a much better grade than the DM110 and DM220 have used in the past). It is a big floor standing system (no speaker stands required) almost the size of the DM2000 (34" high, 11 1/2" wide and nearly 13" deep). It is very efficient and will go as loud cleanly on 25 watts as the DM7/II, for example, would go on 100 watts. It reminds me a lot of the DM7/II (now discontinued and \$1300 per pair) except the DM330 is only \$698/pair!

We of course took apart the first sample to see what B&W had done to achieve this level of performance at a much lower price. We note that the woofer cones, although looking from the outside like mundane fiber cones, are not as simple as they look. The inside surface is completely damped and is acoustically opaque. The dust caps are soft rubber and have nearly no acoustical output. The cast frameworks are damped with dense damping rings pressed into the circumference of the framework, decoupling the active driver from the frame (and from the cabinet). The tweeter uses this same damping material in strategic places (no need for Plast-i-clay on these systems at all! The internal bracing includes a strut running up each side of the cabinet and across the top and bottom, with an additional strut across the cabinet from side to side near the middle. It is very solid. The cabinet is acoustical foam lined. About the only things you give up are the real high quality wood finishes and electronic protection circuits of the "upper end" B&W models.

The sonic quality is very good indeed. The speaker is powerful, very high resolution, very dynamic, and does indeed have a very clear and fast bass response (the cabinet design works as intended). We like the imaging, the openness, and the range. We really like the efficiency as our little MOS-FET CONTROL AMPLIFIER becomes as "big" as a 200 watt unit on an equivalent low efficiency loudspeaker and good 25 watt amps cost a lot less than good 200 watt amps. All other things being equal, a highly efficient loudspeaker is very desirable as you get lots of "free" watts too. Usually, all other things are not equal, and in general efficient loudspeakers get their efficiency by lots of underdamped peaks and resonances, providing pretty awful sound.

But with the DM300 B&W has managed to make things more than equal! This system has no obvious colorations at all, is extraordinarily free of resonances, has no peaks or booms, and still is very easy to drive. The DM2000 is a bit better (wider range and dynamics yet) but at \$698 a pair the DM330 is just as much a steal as the Mission 70 MK II is at \$200 a pair. It will handle 100 watts and has a 2 year warranty. Have you been looking for a fine \$1500/pair floor standing wide range speaker system? Look no further, except we will only charge you \$698/pair for these, including delivery in the continental U.S.A.

*Frank Van Alstine*

## VOLUME THREE NUMBER SEVEN JULY, 1984

Although we have had a series of successful reviews in *Sensible Sound* (SUPER-PAS, MOS-FET 120, MOS-FET 150, SUPER-FET PAT-5, MOS-FET CONTROL AMPLIFIER (SCA-80Q), TRANSCENDENCE 400 and TRANSCENDENCE PREAMP) (reviews of the MOS-FET 150B, MOS-FET 200B, TRANSCENDENCE 200 and SUPER-FET 101 are pending), a favorable review of the MOS-FET 120B in *Stereophile* (review of SUPER-PAS pending), and other write ups such as the 120B review in the World of Stereo column of the *Buffalo News* Sunday newspaper in February, 1984, one of our readers writes to ask why we have no reviews in *Absolute Sound* and wonders why we are "feuding" with them. He claimed to have talked to Harry Pearson about this and was told that "we do not send anything to *Absolute Sound* for review" and that "*Absolute Sound* is not feuding with us, we are feuding with them."

Wrong! As far as we can determine, sending equipment to *Absolute Sound* is as useful as dropping it into a black hole.

We sent *Absolute Sound* a SUPER-PAS preamplifier in early 1980. It was returned to us in late 1982. As far as we can tell, it was never turned on and was never mentioned or reviewed.

On November 16, 1982 we sent *Absolute Sound* a SUPER TUNER TWO and a TRANSCENDENCE PREAMPLIFIER. Obviously, neither piece has been reviewed (for better or for worse) or even mentioned.

In the Summer of 1983, after the highly favorable review of the TRANSCENDENCE 400 was published in *Sensible Sound*, we received a frantic phone call from *Absolute Sound* demanding a sample TRANSCENDENCE 400 and TRANSCENDENCE PREAMPLIFIER right away for review. We pointed out to them that they already had a TRANSCENDENCE PREAMPLIFIER and had been camping on it for nearly a year, and that I didn't really see any point of giving them another \$3000.00 worth of equipment when they had not mentioned anything we had done for the past three years. Obviously, if they want to review our equipment in the future, they are welcome to buy the equipment just like anyone else.

I must mention, however, that I do wonder about their motives. In 1980, *Absolute Sound* did return an old (mid-1970's) Double 400 amplifier to us for update with our current Bi-polar Rebuild circuits. We did the update at no charge and returned the amplifier to them. It was mentioned in *Absolute Sound*. It was listed for sale by them in the next issue.

From your letters, a lot of you are anxious to buy a digital audio disc player now, and are asking me for more advice, so a further follow up on them is in order at this point.

I have several observations (and large remaining doubts).

Bert Whyte, in the most recent issue of *Audio*, informs us that almost all of the digital discs available a year ago were indeed, really bad sounding because of poor recording and engineering techniques. Thanks a lot, Bert! You have done it again! A retroactive bad review saying, in effect, "*Audio* readers, you were a bunch of suckers to believe us a year ago and buy the material advertised in *Audio* then, when now, with better material available, we can tell you we lied to you last year and you should not have bought digital discs then." You told us the first generation Pioneer video disc player had a lot of flaws too, but only after it was out of production. My observation, when even the major audio magazines finally admit that much of the source material was of poor quality, what does that say about current source material? Is it really better, or would downrating it only offend current advertisers?

The last time I discussed DADs, I expressed doubts about RFI shielding, pointing out the digital circuits can broadcast large amounts of very high frequency trash, which can overload electronics and speakers. I mentioned that personal computers must be shielded, but it appeared that disc players had fallen thru the cracks of the government regulations, and were not shielded at all. I suggested that before you purchase a disc player, you try operating a TV set or FM tuner near one, to find out if that unit produced enough RFI to disturb the operation of the TV or tuner. If it does, don't buy it.

To the best of my knowledge, no improvements in shielding have been made and the above advice still stands!

A further doubt is that so many of the units run very hot! They are not power amplifiers, and should run as cool as a preamp or a tuner. Heat is the enemy of electronic parts! Digital switching and logic circuits that are pushed so hard that they make equipment covers hot to touch are not going to be reliable! Check out the model you are interested in, and if the cover or vents get hot, do not buy it.

Prices are still going down, fast! The Technics SL-P7 is now being advertised at \$299.00 by large discount chains in Minneapolis. This sets an upper limit on what you should pay for a disc player. Note that the regional Panasonic rep promised to get me a unit for \$350 at the C.E.S. show last January. He didn't. Now anybody can get one for \$299.00. Thanks a lot Panasonic-Technics!

Another doubt is that the cost of the disc player is going to be a lot more than the initial investment. The discs are \$15.00 to \$20.00 each, and you are going to spend well over

\$1000.00 or more just to have a decent starter collection of material. When I look at my 30 year record collection, it occurs to me that I could spend over \$20,000.00 and still not equal it in digital disc repertory.

Finally, I have a growing suspicion that the current digital disc players will not be the final or even short term permanent format for storing musical information. I have a feeling that every dollar you spend on the current format will be a dollar thrown away!

We are at a beginning level of storing and retrieving audio information in a digital encoded format. We are using a crude system about as advanced as the Apple I. In the near future much faster D to A converters, much more competent memories, much better error correction circuits, and much more sophisticated filter circuits will become available at low cost. At this time, with a 44 kHz sampling rate (the fastest practical with current low cost technology) the filters, which must chop everything over half the sampling rate, cause underdamped ringing on all disc players and terrible transient overshoot. Obviously, as much higher speed converters become available at practical prices, the sampling rate can be scaled way up, and it will then be possible to have simple damped filters that generate no ringing at all and still have flat audio response. Right now I do not know how much audible non-musical trash the filters are generating because I cannot listen to a machine that does not have strange high frequency resonances (they all do!). However, I do know:

1. Every record I own, dating back to the late 1940's, will play on our most modern and high quality record player (yes, 78s do cause a few problems but there are machines and modern stylus assemblies to get the best out of them too). Even my old quality recordings sound better with every improvement in cartridges, arms, and turntables.
2. My records are not, and will not become, obsolete. [*1900 Note: Wrong again!*]
3. When digital disc players change internally to a much faster, and accurate encoding and decoding system, all of the playback material (digital discs) is going to become obsolete and unplayable on the newer format. This is probably going to happen more than once in the next few years! Your investment is going to be obsoleted. Have lots of fun accumulating an expensive and worthwhile collection of playback material, several times. Have lots of money available.
4. Since I am getting at least as good a dynamics and musicality from my FM

tuner in our studio as others are getting on current disc players, I am not overly anxious to buy a disc player yet as it does not seem to add anything to my pleasure! My system is good enough without one.

Certainly the DAD has real advantages regarding noise, dynamic range, and wear, but not enough advantages yet to justify the purchase price.

Now to follow up on a couple of other items.

The helpful Manager of Research and Development of Harmon/Kardon, Mr. Marty Zanfino, did keep his promise and sent me two samples of the T-60 tonearm for our experimental use. Thus we have had the opportunity to tear down a spare T-60 arm and get at the arm bearings without risking damage of a working turntable. That's the good news. Now for the bad news. Sadly, there isn't anything we can effectively do to improve the arm (please understand it is a very good arm in the first place). The problem is that all of the bearings are miniature ball bearing races (two sets vertically and two sets horizontally) with jillions of tiny little balls (produced by constipated ants?) adjusted in conical races for minimum play and friction. Its a work of art. We strongly suspect that lubrication with liquid silicon would make it work better yet. It is not possible to "get to" the vertical bearings without ending up with a lap full of little balls. Thus, we cannot silicon lubricate the vertical arm bearings of the T-60 as we can in the T-25. If you own a T-60 don't worry about it too much, its a darn good unit, if you don't own one, we suggest we can make the T-25 arm work better yet, and at a lower price. We win some, we lose some, and again, thank you Harman/Kardon for your cooperation, assistance, and interest.

Now for some better news. As I previously reported B&W of England sent me a pair of the new TSX-80 tweeters for my evaluation in my 801F loudspeakers. I have them installed now (and they are going to stay installed!). My evaluation, in a word, WOW! Boy oh boy do I feel sorry for anyone who sells a set of 801s before they have heard them with this much improved tweeter. They are going to be sick when they find out their 801s could have outplayed anything else they may have purchased. Our initial evaluation was made by installing one new tweeter and comparing the old and new (with a mono source, of course). No comparison, the system with the original tweeter sounded simply muddy and muted (which is really strange as the original tweeter was noted for its extension and clarity). This is no small improvement, all attacks, ambiance, dynamics, and instrumentation are simply clearer, more intelligible, in a way much like opening a window and letting fresh air in. Vocals, and the top end of female voices are both smoother and more transparent at the same time. Obviously, we didn't spend a lot of time agonizing before fitting the new tweeter in the other 801 of the pair too.

In stereo, the advantages were even more apparent. We can simply clearly hear more of the source. On really fine records, B&W's engineering improvements are really fun, our American Gramophone (*Fresh Aire*) records are a lot better than ever. The new tweeter does cause one slight "problem" though. You can also hear engineering mistakes better too. For example, the Sheffield album, *Growing up in Hollywood Town*, with Amanda McBroom, clearly exhibits transient slewing somewhere in the record – cutting process as cymbal transients simply are not clean. It sounds like they have some exotic and unstable designed by ear amplifier in there somewhere, thrashing away. A pleasant surprise is the new tweeter provides a more dynamic and musical mid-range too. Of course all loudspeakers in a system interact through the crossover, and in this case, the interaction is either less, or provides a result I find to be most favorable. The whole system's dynamic range is simply a bunch better. Aado, upon first listen said, "Acoustat and other electrostatic builders will not be too happy to hear this, will they?"

These new tweeters will be available as a retrofit kit in about two months from your B&W dealer. The price is not available yet. They will be available for the 801, 802, DM7/II and the DM17 models. I am completely sold and urge you to acquire the retrofit kit as soon as it is available. If you can find some sucker selling a set of 801s, now is the time to buy them before he finds out about the tweeter retrofit, as later he may not be so anxious to sell.

Regarding installation of the kit, although a careful amateur probably will be able to manage it, we suggest you have your dealer do it. In the 801, you must remove the head, remove the midrange driver, remove enough insulation to get at the retaining screw for the tweeter head, unplug the tweeter connection cable, remove the tweeter head, snap off the retaining clips for the tweeter dispersion plate, snap off the tweeter grill (without breaking it or mashing the tweeter), separate the tweeter housing, keep track of all the damping parts (6 damping rings), remove the tweeter, and reassemble in reverse order. While it is easy to do it right, it is also easy to stick a screwdriver through a tweeter or midrange cone and make a \$100.00 mistake. Let your B&W dealer do it if possible. You are going to like the results.

Anyway, I now have the first set of 801F speakers in the country with TSX-80 tweeters. They are available for \$3000/pair, delivered anywhere in the continental USA. If you are thinking about 801s I suggest you order ours now. When this tweeter goes into regular production, the price may go up (and then again, it may not, but why tempt Murphy?).

Further follow-up – Dolly Parton is the back up singer on *Simple Dreams*, I had three readers give me the right answer, and several more give wrong answers (they didn't own our equipment).

The response to my offer last month to list those of you who desire to buy or sell used Dyna or Hafler units has been nil – only one response from a person who would like to buy a St-70 power transformer (if you have one, contact me). I am open to buy used Dyna St-120, St-80, St-150 and FM-5 units (need not be in working order) call me at 612 890-3517 if you have any of the above you desire to sell.

We are getting some interesting information from our computer assisted circuit analysis programs as we get our new supermini checked out and programmed. Our main purpose is to solve multiple equations in multiple unknowns quickly and exactly accurately, and to a high degree of precision. We suspect we are the first to have access to the computer power, the need to solve, and the mathematical ability, electrical engineering ability, and programming ability all at the same time to be both motivated to solve and be able to solve complex analog circuits exactly.

The problem in solving circuits is pretty simple to explain. We are dealing with parts whose values, when expressed as a number, encompasses a huge dynamic range. For example, a 1 M Ohm resistor is 1,000,000 ohms. A 12 pF capacitor is 0.00000000012 farads. Try dividing 1,000,000 by .00000000012 on your pocket calculator or IBM or Apple computer and see what answer you get. You most likely will get an error message. The answer is not "error message." Essentially, in trying to solve complex equations of large dynamic range on a computer, two bad things happen. The first is rounding errors as the computer rounds off values to within its internal limits. Now you are solving problems using parts values the computer is randomly substituting for the real world parts you have in the circuit. You may get answers, but they will be wrong answers, for the rounding errors have changed the circuit.

The second problem is the rounding may round a very small value (such as the 12 pF capacitor above) to zero. Now the part vanished from the circuit as far as the computer is concerned. Again, it may return answers, but wrong answers, for it randomly eliminated parts from your schematic. Of course, rounding to zero also caused the "error message" when you tried the division problem suggested above. The 12 pF capacitor probably rounded to zero, and you cannot divide by zero. When the computer tries to do this, it stops (or crashes). You get no answer at all. That is not very helpful either. It takes a sophisticated computer and very complex programs to solve circuit problems without rounding errors (and to get results without six months of computer time per step). This is the reason that engineers typically simplify the circuits they are solving to get problems that will fit within the scope of their available computer power and programs. They assume the simplified circuits will give them approximately correct simplified results. They are wrong, the results we have found, are in many cases not even in the ballpark.

As we begin a preliminary investigation of the real world behavior of analog circuits, we are finding some very large problems. For example in a vacuum tube triode circuit, the value of the plate resistor is the main gain determiner. Obviously, the goal is to have the closed loop gain of the circuit the same at all frequencies and under all operating conditions (flat response). However, the plate resistor (when carefully considered) turns out to be, in effect, in series with the power supply capacitor. The capacitor, of course, goes open at very low and at very high frequencies. Thus the plate resistor goes open at very low and very high frequencies. The real value of the plate resistor changes dynamically with signal conditions, and the circuit is really a variable gain circuit and is completely screwed up at low and high frequencies. You have random treble and bass boost circuits at work. Sorry folks, "vacuum-tube bass" isn't music, it is simply a completely diddled circuit at work, doing its own thing with no correlation to input signal at all.

*Frank Van Alstine*

## VOLUME THREE NUMBER EIGHT AUGUST, 1984

Now, for something completely different, an issue devoted to the Dyna St-120 amplifier, both trouble shooting the stock unit (nobody out there seems to know how to properly fix one) and a do-it-yourself construction project - a power mos-fet power supply section for the St-120 (the same as we use in our complete MOS-FET 120B amplifier which interfaces nicely with the stock Dyna output circuits too).

The Dynaco St-120 was probably the most popular solid state amplifier ever in production with well over 100,000 units sold. It has also (from our experience of building and installing new circuits in thousands of them) probably had more improper and incompetent repair work performed on it than any other amplifier too. We get many calls from owners and from repair shops too, asking for St-120 parts and advice as how to fix them. Almost always, people ask for the wrong parts - parts we know do not normally fail, parts inadequate to make the repair, and a parts list that we know overlooks the real "trouble spots." We know that many units are simply junked in despair after blowing up again and again after costly, but incompetent repairs, and this is not right. The unit can be made to run solidly if repaired properly and of course we would much rather see those "junkers" come here for our new circuits than being thrown away or becoming a permanent resident of the closet.

Because Dyna St-120 amplifiers tend to blow up a lot and seem to be so difficult to properly repair, there is one advantage to you, dear reader. They do tend to turn up cheap at garage sales and flea markets. More than one of my customers has found useful St-120 amplifiers for \$10.00 and sent them here for new circuits. With the informa-

tion that follows, you probably can make a \$10.00 special into a pretty fair little power amplifier without sending it here.

At the end of this issue, I have printed the final version of the St-120 audio output schematic and parts list (the-stock circuit, not our mos-fet output circuit). Since the St-120 audio circuit was changed and, in general, improved many times in its long production life, it is very important that you compare your audio circuits to this schematic and update your unit to this schematic which is the most stable version. We will go through Dynaco's own audio circuit changes first.

The earliest St-120 amplifiers did not have R27, R28, R29, C13, C14, C15, and the value of C6 was 50  $\mu$ F at 10 volt (non-polar). These first units also used selected RCA 2N4347 output transistors in all applications. These were all factory wired units built in 1967. By the time the first kits were released, several changes had been made, changes you should make too if you still have an original version.

The first change was the addition of R27, a 0.47 ohm 2 watt emitter resistor to stabilize the outputs. Next R28 was added, a 3.3 ohm emitter resistor for Q4 for further stabilization. This can be added to old cards by making a couple of foil cuts and soldering the resistor to the foil side, and is necessary for stable operation. C14 (.001  $\mu$ F) was added at this time to eliminate a turn-on "zip" sound. The output devices were changed to spe-

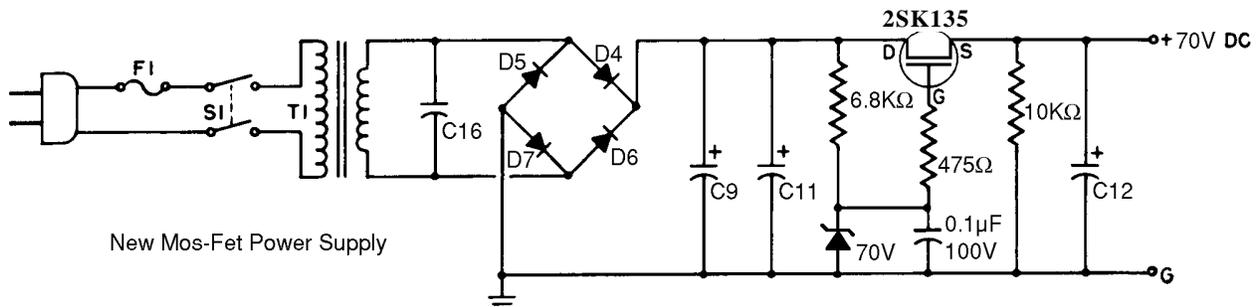
cial select 2N3055 transistors (more about these later).

Much later in the production life of the amplifier (mid 1970s) further important changes were made. As the amplifier aged the front end became unstable (Q1-Q2 circuits). Many amplifiers turned into full power high speed oscillators and instantly blew-up for no good reason. The result was blown output transistors. Many times, after replacing the outputs, the amp simply blew up again! The oscillations occurred so fast, and so destructively, there was not time to measure the problem on an oscilloscope before the amp turned into slag again. The "cure" was a change in value of C13, and the addition of C15 to stabilize the front end. You must do this to your St-120 if you want reliable operation. C13 is changed from 27 pF to 68 pF. C15 (27 pF) is added. In addition, C1 was changed to a tantalum capacitor (5  $\mu$ F 15 volt), and C6 was changed to a .47  $\mu$ F 100 volt film capacitor. Make these changes to your amplifier too. The final production changes were the addition of R29 (1000 ohms) from each red to black output jack to provide a load for the output caps under open circuit operation, and the change of driver transistors from 2N5320 and 2N5322 types to a heavier TIP31 and TIP32 type. Making all of these changes will give you a much more reliable amplifier.

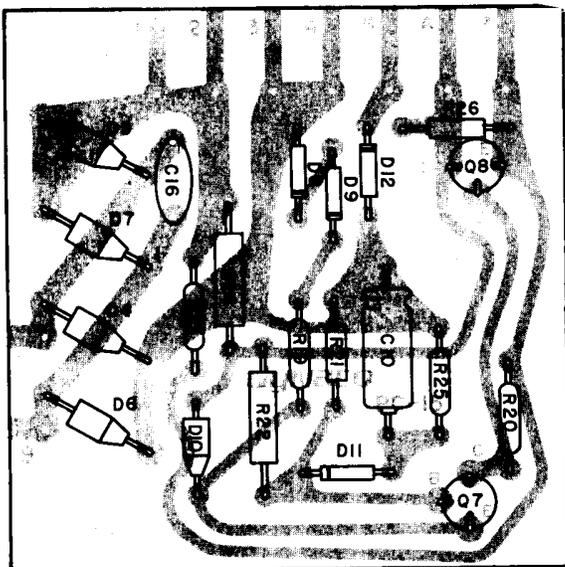
However, the problems really start when the amplifier fails. In general, the major problem is

repairs made with inadequate (general purpose or too low a voltage rating) output transistors. Dynaco used special 2N3055 devices with a 90 volt rating. Standard 2N3055 outputs have a 60 volt rating and since the power supply puts out 72 volts, will fail quickly as they are overvoltage! Standard replacements for the 2N3055 (HEP, ECG, SK, Tobisha, etc.) have even poorer specifications and are even less reliable in this circuit! Essentially, if a St-120 amplifier output stage fails, Q5, Q6, Q3, Q4, and D1 must all be replaced with parts meeting or exceeding Dyna's original specification for long term reliable service. A shorted output usually "kills" R27 too. Since it is very difficult to find high voltage 2N3055 output transistors, we find a useful replacement to be the much stronger Motorola 2N5630 output transistors, as used in the Dyna St-400 amplifier. In addition, Q3 can be replaced with the St-400 2N3440 and Q4 with the St-400 2N5416 predriver transistors for further durability improvements. Original Dynaco parts are available from Stereo Cost Cutters, Box 551, Dublin, Ohio 43017. Write them for their Dynaco parts catalogue.

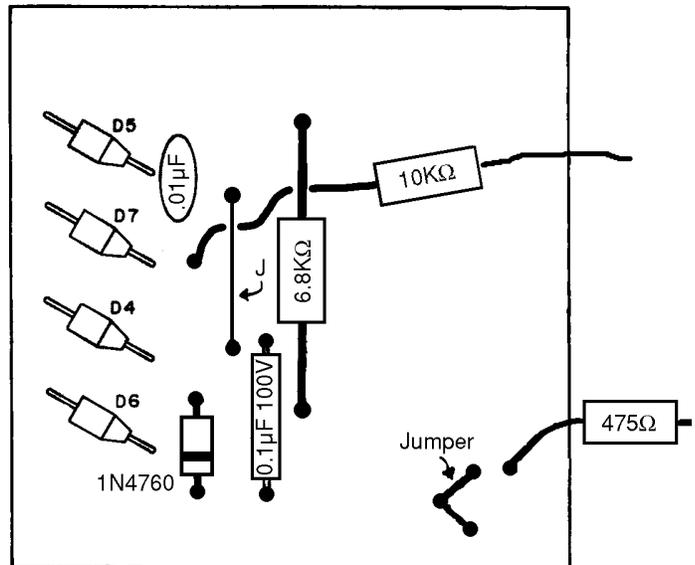
When one channel of a St-120 fails, this "overloads" the power supply (common to both channels) causing (hopefully) the power supply to "shut down" cutting power to both channels and with any luck at all, preventing further damage. Thus many people who think they have both channels out, in fact, do not. Only one channel has failed, causing the power supply, and thus the



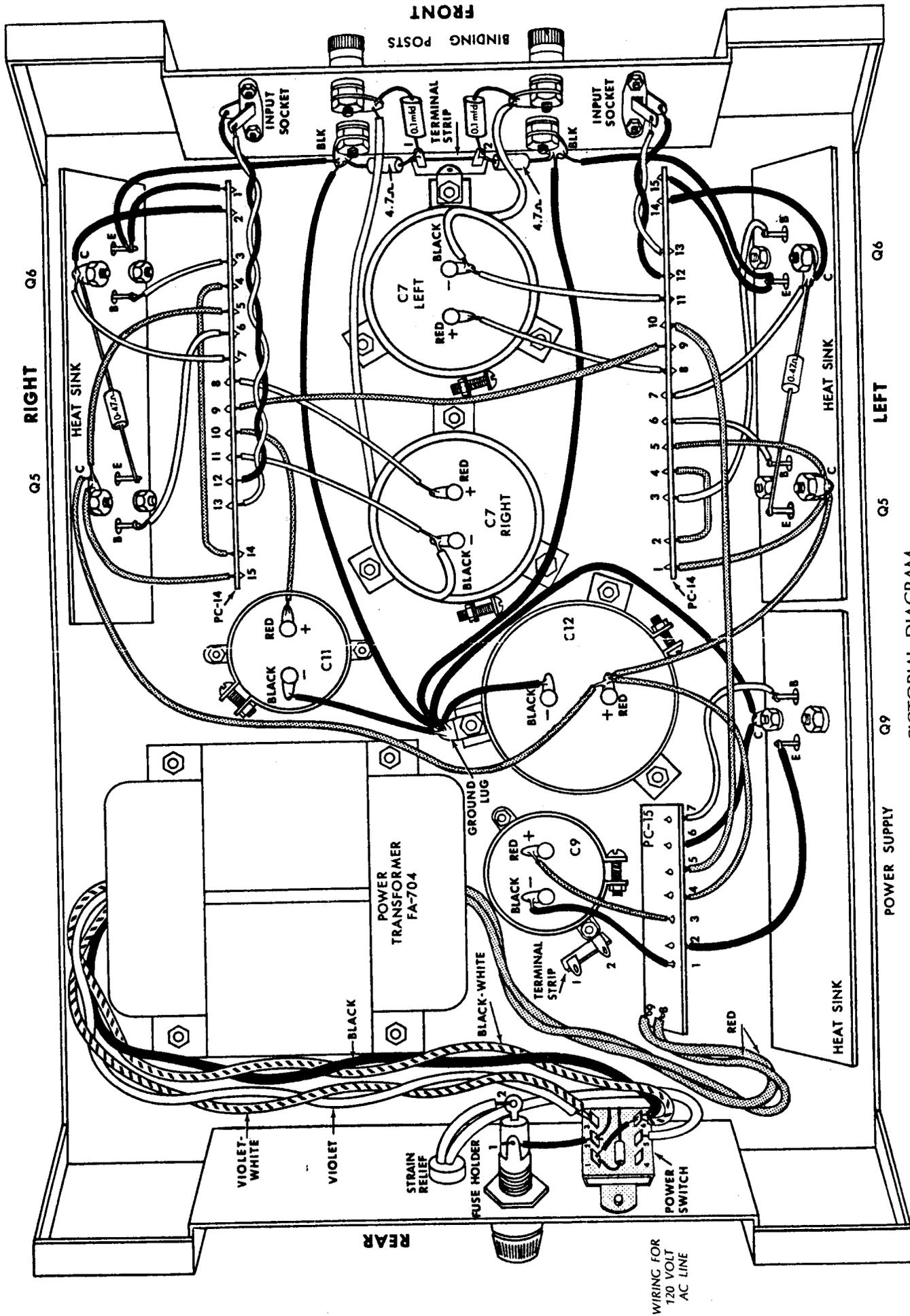
New Mos-Fet Power Supply



Original Power Supply Board PC-15



Revised Power Supply Board PC-15



REAR

FRONT

RIGHT

LEFT

Q6

Q6

Q5

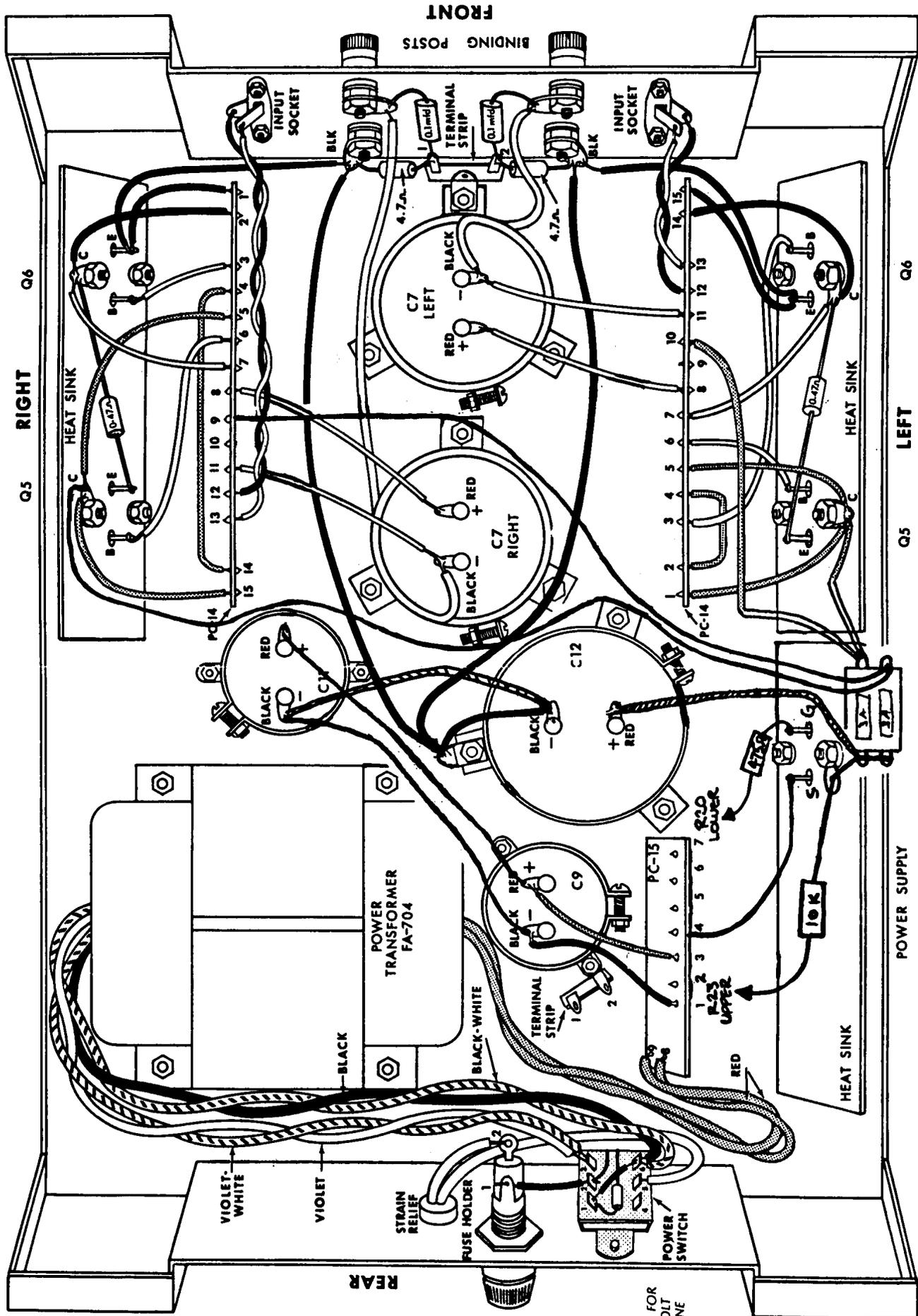
Q5

POWER SUPPLY

PICTORIAL DIAGRAM

ORIGINAL ST 120

WIRING FOR  
120 VOLT  
AC LINE



PICTORIAL DIAGRAM WITH MOSFET POWER SUPPLY

ST 120

WIRING FOR  
120 VOLT  
AC LINE



other channel to shut off too. To trouble shoot, disconnect the B+ supply feed from first one, and then the other channel to find out which channel (with the other disconnected from and thus not loading down the power supply) still works. Many people have attempted and/or paid for two channel repairs when only one channel was defective.

The worst case problem is when one channel fails, and the user still attempts to drive the other channel. The protective circuits in the power supply will only hold up for a limited time before failing too. This causes the power supply transistor to blow, and the supply deregulates, going up from 72 to over 90 volts, thus overvoltageing the remaining good channel (and the still working parts in the defective channel) causing every transistor in the unit to melt, frizzling resistors and circuit foil too. For this, you get a plaque mounted on the wall, with the stuffed back half of a cat mounted on it (a catastrophe)!

If the power supply section fails, one of two things happens. The worst problem is described above, an overvoltage condition, with in excess of 90 volts DC at C12+, and probable major damage to the audio circuits. Sometimes the supply fails open, and the voltage at C12 will be near zero. A simpler failure (and quite common – especially in the summer when there is lots of power line transients) is a blown supply diode (one or more of D4, D5, D6, and/or D7) which will vaporize the line fuse but cause no further problems downstream, assuming the shorted diode(s) are located and replaced. Once in a while, the zener regulation diode (D10) will fail in a “low regulation voltage” mode. This will cause the supply output to drop to some lower voltage than the specified +72 volts. The cure for this simple problem is just to replace D10 with another 58 volt zener diode. The regulated power supply of the St-120 is a mess and nearly impossible to fix reliably at a rational cost. If any transistor goes, Q7, Q8, and Q9 must all be replaced with transistors of Dynaco specifications (matched together) and biasing resistor values must be “tweaked” to get things to work properly.

This is a design problem due to the inherent characteristics of bi-polar power transistors. The power supply must supply up to 6 amperes of regulated current at 72 volts. The power supply main series power transistor (Q9) has a beta (gain) of about 15. This means that to control 6 amperes of current, it must have up to 400 milliamps of current driving its base. The control reference is a zener diode (D10). It can only supply about 20 milliamps of current. Thus the current from D10 must be further amplified by Q7 and Q8 to provide enough current to supply the audio circuits. Thus we end up with a multistage amplifier in the supply regulator, which is inherently unstable. Thus it must be compensated (slowed down) to be stable and thus supplies, in effect, no current

at all at high frequencies. Further circuits attempt to shut down and protect the supply in case of output failure, and other circuits try and provide a slow turn on to avoid thumps in the speakers. If all supply circuits are not exactly matched, it may not turn on, it may not regulate, it may turn on too fast, it may shut off too soon, or not at all. It is a real “bitch” to fix and make operate well. Thus, when we get a 120 in for repair only with a power supply problem, we never “fix” the original power supply, but simply install our own mos-fet power supply from the MOS-FET 120B amplifier which I shall now tell you how to do yourself.

The power mos-fet transistor we use (Hitachi 2SK133, 134, or 135) has nearly infinite current gain and can be controlled by a single zener diode. It has more current capacity than the transformer can deliver and can be protected by simple B+ fuses, it needs no “slow down” stabilization for the single stage circuit is inherently stable and thus has a bandwidth into the megahertz range and can supply current for high frequencies too. It cannot thermal run-a-way and requires no electronic protection. It is a simple circuit (six new electronic parts replacing the 17 original supply parts) and it will make your amplifier sound better.

The parts required are 1 Hitachi 2SK135 N channel mos-fet, 1 70 volt 1 watt zener diode, 1 .1  $\mu$ F at 100 volt film capacitor, 1 475 ohm 1/2 watt resistor, 1 10,000 ohm 3 watt resistor, and 1 6,800 ohm 2 watt resistor. A dual fuse block containing two 3 ampere quick blow fuses is mounted on the power supply heat sink above the power mos-fet, and the audio circuits and power supply capacitors are rewired to interface with the new power supply. A .01 at 1000 volt capacitor is added across the diode bridge to suppress switching transients. We can supply a power supply parts kit (the parts described in this list) for \$35.00 including shipping. “Hand holding” (if you screw it up) costs extra!

Anyway, assuming you have a St-120 that now has audio circuits in working order, here is how you install the new mos-fet power supply. (Refer to the print of the Dyna St-120 pictorial diagram supplied at the end of this article).

Unsolder all the wires to PC-15 eyelets 1 through 9, remove the black wire from Q9-C to the chassis ground lug, remove the two screws holding the power supply heatsink in the chassis (one in a rubber foot) and remove the power supply module from the chassis.

Unsolder and remove the red wires at each audio channel (PC-14) eyelets 9 and 10 and at the red (+) terminal of C11. Unsolder the red wires (three) at C12 red (+). The red wires from the left and right audio channel Q5-C will be reconnected later to the new fuseblock.

Remove the three long screws and spacers holding PC-15 to the heat sink and remove PC-15. Also remove Q9 from the heat sink but save the mounting hardware.

Clean the thermal compound from the heat sink assembly. You will need to make a trip to Radio Shack for a small tube of white thermal compound for mounting the new mos-fet power transistor and to sink the heatsink to the chassis upon reassembly.

Remove (unsolder) all the parts from PC-15 except the power supply diodes (D4, D5, D6, D7). If there is already a .01  $\mu$ F at 1000 volt capacitor installed across eyelets 8 and 9 it can remain, if not, a new capacitor will later be installed.

Refer to the layout sketch of PC-15 (power supply circuit board). Now install the following new parts (all on the component side): A jumper wire connecting Q7 C, B, and E eyelets; a jumper wire in the R24 location; a new 6.8 K ohm resistor from the top hole of D8 to the bottom hole of R19; and a new .1  $\mu$ F capacitor (104K) in the R22 location. Install a new 70 volt zener diode (1N4760) (banded end pointing down) in the D10 location. All connections are, of course, to be soldered. Add a .01  $\mu$ F at 1000 volt capacitor (.01M) between the foil at eyelet 8 and 9 if one is not already installed (true in late model St-120 units only). Clear the solder from the following holes for reuse (use solder sucker or round wood toothpick): eyelets 1, 3, 4, 8, 9, the bottom hole of R20, and the top hole of R23. Inspect the PC-15 card very carefully to insure that no solder bridges (Lloyd’s cousin) or foil breaks were made in removing the original parts or installing the new parts.

Now mount the new Hitachi 2SK135 output mos-fet transistor on the heatsink in the Q9 location. Coat the transistor mounting surface with thermal compound, slip the mica insulator on the leads, press it against the mounting surface, coat the insulator with thermal compound too and press this surface against the heatsink with the leads pointing through. Note the pins are offset and the transistor will only “line up” properly in one orientation (pins offset towards the top of the heatsink). Press a new shoulder washer into each mounting hole from the inside. Install two new #6 screws through the transistor. Fasten the bottom screw with a #6 lockwasher and nut firmly tightened, fasten the top screw with a #6 solder lug (pointing sideways directly towards the power switch end of the chassis) and another #6 nut, firmly tightened. It is very important that the transistor (and all mounting screws and the transistor pins) be isolated from the heatsink (no metal to metal contact). The original transistor was not isolated as it was a different circuit configuration.

Install the new fuseblock on the inside of the heatsink above the new transistor. It is fastened with one #6 screw through the top hole in the block from the inside, through the top free hole in the heatsink, and with a #6 lockwasher and nut on the outside of the heatsink, firmly tightened. It is located so the fuses will be parallel with the bottom of the chassis. Reinstall the rebuilt PC-15 card on the heatsink in its original location and orientation reusing the three original sets of long #6 screws and spacers.

Install a wire from the left (power switch end) side of the top fuse clip to the bottom fuse clip to the solder lug at the top #6 screw of the power mos-fet transistor (solder at the bottom fuse lug only at this time). Install the 10,000 ohm 2 watt resistor (brown, black, orange) from the mos-fet solder lug to the previously opened top hole of R23 on PC-15. The resistor will be placed between the PC card and the heatsink. Make sure a lead cannot touch the chassis, heatsink, or the mounting spacer for PC-15. Solder both ends. Install an insulated wire from the power mos-fet pin closest to PC-15 to eyelet 4 on PC-15 and solder both ends. Install the 475 ohm resistor (4750F) from the open bottom hole of R20 on PC-15 to the remaining mos-fet pin (furthest from PC-15). Locate the body of the resistor as close to the mos-fet pin as possible and keep the lead between the body and the mos-fet as short as possible.

Reinstall the power supply module in the chassis in its original location. It is easiest to first connect and solder the two red transformer leads to eyelets 8 and 9, then coat the heatsink mounting flange with thermal compound, and then fasten it in place with two sets of #6 hardware (including the original rubber foot on the corner mounting screw). Make sure the red leads cannot be "trapped" or pinched by the sink, chassis, or cover. Look also at this time at the other power transformer leads on the outside of the power transformer. Many times these are located so they can be "squashed" between the chassis and the inner cover flange when the cover is reinstalled. Correct this problem now if it exists.

Reconnect the black wire from C9 negative (-) lug to eyelet 1 on PC-15. Reconnect the red wire from C9 red (+) lug to eyelet 3 on PC-15. Connect an insulated wire from the top left new fuse lug (PC-15 side) to the red (+) lug of C12 (solder all connections). Connect a new insulated wire from C9 black (-) to C11 black (-). Eliminate the original wire from C11 black (-) to the chassis ground lug. Connect a new wire from C11 black (-) to C12 black (-). Connect a new wire from C9 red (+) to C11 red (+). Solder all connections. The power supply rebuild is now complete except for connecting it to the audio circuits and testing.

Connect an insulated wire from right channel Q5-C solder lug to the bottom right fuse lug (furthest from PC-15). The original red wire previously connected at C12 red (+) is probably too short and will need to be replaced with a new wire. Connect an insulated wire from right channel PC-14 eyelet 9 to the same lower right fuse lug on the power supply heatsink and solder all connections. Connect the red wire from left channel Q5-C solder lug to the top right fuse lug on the PC-15 heatsink. Connect an insulated wire from eyelet 9 on left channel PC-14 to this same right top fuse lug and solder all connections.

This completes the wiring. Now test the power supply operation before installing the two 3 ampere quick blow fuses connecting each channel's B+ supply to the new mos-fet regulated power supply. A DC voltmeter is required. With the 3 ampere slo-blo main chassis mount line fuse installed, but with both 3 ampere quick-blo B+ fuses not installed in the new dual fuseholder on the power supply heatsink, plug in the amplifier and turn it on. If the power supply is working properly, the DC voltage should read about +70 volts from C12 red (+) to ground with less than 10 millivolts of AC ripple. The DC voltage from C9 red (+) to ground should read about +90 volts DC with less than 2 volts AC ripple. The new power supply heatsink should not get hot (under any load) and the main line fuse should hold. If the fuse blows, or if any voltage is improper, unplug the amplifier and check your work for wiring errors and/or solder bridges and bad connections. If the voltage at C12 is low then probably the zener diode is defective. An immediate failure of the line fuse (splattered) indicates a shorted main diode (D4, D5, D6, or D7). You must achieve proper power supply operation before connecting the B+ fuses to avoid subsequent damage to the audio circuits.

Assuming that everything checks out, turn off the amplifier and let it set for 1/2 hour for the supply voltages to decay, then install the two 3 ampere quick-blo fuses in the new B+ fuseblock and try the amplifier again. All fuses should hold, the B+ voltages should remain the same as before. The DC voltage from C7 red (+) for each channel to ground should read about +35 volts DC (about one half the regulated power supply voltage). If these conditions are true, you may now reinstall the amplifier in your system and hear cleaner sound. Note that now each audio channel has an independent B+ fuse in series with its output transistors and an overload, output short, or audio channel failure will blow the associated B+ fuse, protecting the power supply and allowing the unaffected audio channel to continue normal operation.

The following are the necessary schematics, diagrams, and sketches for the mos-fet power supply conversion. Note that our mos-fet audio circuits may be added to your amplifier at any time, but

not as a do-it-yourself kit. The audio circuits use complete new circuit boards and a very sophisticated layout and must be done at our shop. If you have successfully installed this mos-fet power supply yourself, you may deduct its parts cost (\$35.00) from the full cost of the MOS-FET 120B rebuild if you send the amplifier to us for the new audio circuits.

*Frank Van Alstine*

## VOLUME THREE NUMBER NINE SEPTEMBER, 1984

I have an interesting topic for your consideration this month – what to watch out for when you are shopping for used audio equipment.

In this discussion we will assume you are considering a piece of equipment you find musically satisfactory and the unit is in good mechanical and electrical condition and all functions work as intended. Obviously, if it does not now work properly, avoid it unless an easy and inexpensive fix is immediately available.

Do not get carried away with a large price reduction on a very expensive piece of equipment without first asking yourself if perhaps much less expensive new equipment is available that is better yet. Paying \$800 for a five year old \$2400 preamplifier is not a good deal when there are new \$400 – \$600 preamps available that are much better yet. Think before you buy.

In general, avoid old vacuum tube equipment, especially power amplifiers and FM tuners. This equipment runs very hot, aging and changing the values of internal components, degrading overall performance permanently. Power output tubes are now expensive, unreliable, have short service lives, are difficult to find, and tend to fail in modes that destroy output transformers and other expensive components. Many vacuum tube tuners cannot now be properly aligned because heat has caused internal damage to the IF and MPLX transformers. We do build a new circuit in the Dynaco PAS preamplifier that is cool running and reliable, but this is a rare exception to the usually unreliable vacuum tube equipment of today.

Ask the following questions before you buy with the firm understanding that a "no" answer disqualifies that component from further consideration:

Is the manufacturer still in business? If not, you probably will not be able to get the equipment repaired if a flaw develops later. There are a few exceptions to this rule that will be discussed later.

Does the equipment contain "potted" (epoxy encapsulated) circuit modules – little black boxes hiding parts of the

circuits? If it does, it cannot be repaired by other than the manufacturer as a repair shop cannot determine what is inside the module. Do not buy it. Note, we can replace the potted modules in the old VA Model One preamp with our serviceable SUPER-FET circuits, but this is a highly unusual exception to the rule.

Did the manufacturer furnish a complete schematic diagram and parts list for the equipment and is this data available to you along with the equipment? If it is, a competent service agency can probably service the equipment even if the manufacturer is out of business.

Is the equipment built with industry standard "O.E.M." parts? If it is, a service agency can easily obtain exact and proper replacements. Note – do not allow your equipment to be serviced with "general replacement" parts such as RCA SK, Motorola HEP, Sylvania ECG, or equivalent general replacement Toshiba "one transistor fits all applications" type of devices. These are essentially unspecified devices of much poorer quality and performance than the original O.E.M. "2N" series parts and will not work reliably in most circuits. We have seen countless Dyna 400 and 120 amps improperly repaired and blown again because of underrated hobbyist grade repair parts.

Beware of "house brand" or unmarked parts in the unit you are considering. For example, the late lamented Great American Sound Company (GAS) used transistors marked GAS-1, GAS-2, etc. in their electronics. Want to find the proper replacement for a "GAS-1" transistor today? Obviously, you cannot, and thus a GAS amplifier with a minor defect becomes a candidate for the junkpile.

Is the product built with reasonably standard, durable, and available hardware? One reason we still have good results with Dynaco equipment is the hardware was very durable and parts are available in large quantities from Stereo Cost Cutters of Dublin, Ohio. We have never seen a bad transformer in a solid state Dyna unit and the chassis were built to last forever. Jacks and switches are "off the shelf" items and we can be sure of long service life without depending on Dynaco factory service. You might have a bit more trouble, however, finding replacement panels for Acoustat electrostatic speakers, for example (although they do have a good reputation for durability). In general, the more bizarre and esoteric the design, the more likely it is that you will be able to ever get it fixed.

Do not buy a used phono cartridge! The chances are very great it will be defective or damaged.

Remember, the owner is selling it because he no longer likes its sound or because it doesn't track properly, and you do not need to purchase his problems. In addition, the magnets in the cartridge age (get weaker with time) degrading performance. The elastic material in the suspension ages too, becoming stiffer with age, or slowly compressing. This causes the tracking to degrade and/or the stylus to ride too low and bottom. The useful service life of a durable cartridge is probably a maximum of two years, and we understand most moving coil cartridges "wear out" in less than six months. Actually, by the time the stylus wears out in your cartridge, you should consider a complete new cartridge rather than a stylus replacement. Improvements in cartridge design have come along so rapidly that it is probable a new, inexpensive cartridge will perform better and cost less than a stylus assembly for an older expensive cartridge.

Do not purchase used mechanical components (turntables or tape decks) except under very special circumstances. Tape decks wear out very rapidly and repairs are very expensive. There are very few shops that can install replacement heads in a tape recorder and return the unit to its original specifications. In general, you will get much better performance in a new inexpensive tape deck, such as a Sharp RT-150 (available for under \$100!) which will cost less than typical repairs for a used unit. When it wears out, throw it away and get another new one. Used turntables have similar problems. Direct drive units have motors (magnetic fields) located near the bearing assembly, attracting magnetic particles into the bearings. This causes rapid bearing wear and increasing rumble. Turntable main bearings are damaged if the unit is transported with the platter on. The platter "bounces" up and down, pounding flat spots in the bearing. Can you be sure a used turntable you are considering has never been transported with the platter on? Shipping a turntable (except as the manufacturer's original shipment properly packed in all the original shipping material) nearly always causes damage. End users seem never to save all the packing material or repack the turntable properly for reshipment. This is the reason we will not service turntables owned by clients that must be shipped here unless we originally sold the unit and the owner has kept the carton and packing material and has repacked it according to our instructions. The seller might have a just wonderful used turntable for sale, but it probably will no longer be just wonderful by the time he gets it through the UPS or US Mail system to you.

Do not use US Parcel Post for shipping audio components. United Parcel Service has a much better reputation for safe handling of packages and tracing lost or damaged packages is much easier. (I have heard rumors that suggest the Post Office maintains a herd of elephants with

"fragile" stamps located on the bottom of their feet. When they get a whole room full of parcels, they then run the elephant herd through the room to efficiently stamp everything "fragile.") One true story is about a high school girl's science project of a few years ago. She attempted to determine just what shock loads packages in the US Mail system were subjected to. She did this by mailing packages containing recording accelerometers across the country. (Shocks and drops would show up as "earthquake" like blips on the recorded graph.) She did not get the results she expected because of lack of data. One package was simply lost! Another was completely smashed, test instrument and all. Enough said.

When purchasing used loudspeakers, find out the manufacturer's policy on supplying replacement drivers and other internal components. B&W, for example, does have replacement parts available for every dynamic loudspeaker system they have ever built, and B&W dealers have complete parts lists and prices available. In addition, B&W parts "bolt in" easily without the need to ship cabinets across country and without chances of marring cabinets or drivers. In contrast, some speakers are put together with hot melt glue and wood screws, and defective parts must be "chiseled" out with a good chance of turning the cabinet into splinters. Some speakers, such as DCM Time Windows, cannot be user or dealer serviced at all. For a repair as simple as a tweeter replacement, you must ship the whole speaker cabinet back. This makes a simple repair very expensive and time consuming. In general, loudspeaker manufacturers that make their own drivers (KEF, B&W, and a few others) are much more apt to be able to provide good service than a great number of "box makers" that buy speakers from outside suppliers. These companies are dependent upon the whims of their suppliers for replacement parts for older models. Although they may be able to adapt their new designs to drivers with changed specifications or from a different supplier, it may be impossible for them to supply you with an exact replacement for an older product. If this problem occurs, we suggest you replace the same driver in both speakers so that you obtain, at least, the same performance in both speakers. If one speaker has a different driver than the other, imaging will suffer badly as the phase and gain response of each speaker will be different.

Of course a major advantage of buying used loudspeakers is that in general the cabinets can take a lot of abuse without affecting the performance of the unit. A marred, sacred, and stained cabinet (assuming no cracks or air leaks) may look bad, and have low market value, but still sound just fine. If you are more concerned about the sound of your system than the look of your system, you may find a used high quality

speaker for a low price simply because it doesn't look high quality any more. One further caution, if the manufacturer supplied the speakers as matched pairs, make sure you get a matched pair! Check the serial numbers to make sure.

We suggest you avoid equipment that has been "modified" by other than a reputable manufacturer. In particular, avoid units with "magic capacitor" and "good sounding wire" modifications, especially if the insides look like a bird's nest of oversized parts hanging in mid-air. The "modifications" void the warranty, and many manufacturers will refuse to service the unit at all! The amateur modifications may have damaged the original circuit cards beyond repair and changed the operation so that nobody can repair it again. We see many Hafler DH-200 and DH-220 units that have been "modified" beyond belief and have blown sky high. Luckily for their owners, we do not care how badly a Hafler has been "modified" when it comes here for our complete new circuits. We simply throw the old circuits in the ashcan, problems and modifications and all. We can make silk purses out of sow's ears. Of course we void the original Hafler warranty. But we do supply our own warranty, along with a complete schematic, parts list, and service data. In essence we are the manufacturer if the unit after we have rebuilt it and provide the same customer support the original supplier did. If you do not have this kind of factory support for a "modified" component, do not buy it.

In considering any used purchase, beware salesmen's promises that "their service department will be able to take care of any problem." The salesman is not the repairman and likely does not know if the unit is serviceable or not. Check directly with the repair department about the serviceability of the equipment and get any promises of future service in writing. In general, any salesman claim or representation that the store owner is not willing to confirm in writing as part of your sales contract is a worthless claim. Regarding "lifetime" warranties, find out whose lifetime they are talking about. You will be most unhappy when you bring the unit back, after it dies, and find out, "we regret to inform you that you are indeed correct, this unit is dead, and thus its "lifetime" is over. Where should we bury it?"

Well then, with all these pitfalls, why consider used equipment at all? Consider it because you can, if you are careful, really get some fine audio gear for very low prices.

Many "audiophiles" are very insecure about their equipment and trade component at the "drop of a review." They do not own equipment for enjoyment of music, they own it to possess the "latest and greatest" according to the whims of the underground press. Thus, when their "pet" component "falls off the charts" of their audio guru, replaced by another

"latest and greatest," the audio neurotic then wants to sell that component in the worst way. They have to get rid of that bad sounding, crummy, no good unit right now! Cost is no object. The objective value if the unit doesn't matter. They don't care that it did sound just fine last month, until somebody told them that it really isn't good any more. They cannot separate someone's opinion of the equipment from the actual performance of the equipment. They won't trust their own ears, they have to borrow the reviewer's ears (which, in fact, are no more calibrated than their own). This is where you come in.

Since the owner wants to get rid of the equipment right now in the worst way, you can purchase it at a very good price. It doesn't matter what it did cost and how well it did perform, someone who decides he no longer "likes" his equipment will take a very low price for it just to get rid of the "junk." If you can buy quality equipment for a small fraction of the original price, and at the same time "help out" the poor deluded audiophile by taking the trash off his hands, why not be of service? I recently received a phone call from a person who had just purchased one of our SUPER-FET preamplifiers used from a private party for a very low (about \$150) price. The seller had decided he just had to have a new \$1800 vacuum tube preamp and that it sounded "much better" than the SUPER-FET, thus the SUPER-FET was "junk" and had to be unloaded – cost no object. The buyer called me to explain this, and to inform me he listened to both units in the seller's system. According to the buyer's ears, the SUPER-FET sounded much better than the seller's new exotic vacuum tube job, but he kept his mouth shut, and walked out with a steal! He reported to me, "Your preamp is much better than that guy's new \$1800 unit, and I had a hard time not telling the guy so, but I didn't, to make sure he didn't change his mind and not sell it. That guy is crazy." The caller made may day and what more can I say?

One further observation regarding purchasing used equipment. If in doubt about the status of the product, call the manufacturer before buying. Many will be able to inform you about the status of the product, including checking serial numbers to insure the unit is not stolen. If, for example, you can furnish us with the name of the original owner and date of our original sale to him (we furnish dated receipts with all our sales) we will be able to inform you if the unit is current production or our of date, and what possible costs might be involved to upgrade it to present production status if you desire. This is an easy way to keep from being ripped off by a dishonest seller. Having too much data about the product you are considering cannot hurt you.

So, going shopping for used equipment? Do it right. We don't want a call from you saying, "I just got a great deal on this Quatre Gain Cell amplifier, it doesn't work, but the guy I bought it from said you can fix it free." Sorry, we can't. Call first, not afterwards. Good luck!

I will finish this issue with a few last thoughts about Compact Disc Players (aka Seedy players). You will hear no more from me on this subject until the product changes enough to make a report necessary.

I have had the opportunity to carefully evaluate several units in our shop during the past two months. We even got to take one Sony model apart far enough to get a good idea of its internal parts quality, layout, and circuit operation. In addition, I have obtained a complete service manual for the Magnavox 1000 model and have done further research on it.

Most of our listening was done using some of the very best Telarc Compact Discs available, many of which I have also on analog record format. To make a careful comparison, we ran the Compact Disc and the record at the same time switching back and forth from phono to spare inputs on the Transcendence preamplifier.

Our subjective observations are as follows:

In a few cases, such as the Telarc DG-10040 Chopin piano recording, the CD version won hands down. Obviously, the analog record could not cope with the piano transients as well as the CD system could, and the musical reality of the CD was superior.

With many Telarc CD recordings, a sense of "haze" or "busy mud" was absent from the music, a big plus for the CD. (I suspect some "golden ears" think this "haze" was "ambiance" the CD was wrongfully not playing.) The CD can provide more clarity and less trash in the mid-range.

On certain vocals, the "tracked better" especially on high level passages. On records I have played many times for demo use, and are showing some wear, this "tracking" improvement was most pleasing on the CD.

On certain intimate passages of classical performances, the dead silence of the CD tended to "draw" one further into the musical experience—you could hear further into the quiet passages. This is a pleasing plus for the CD.

However, on all CD units and discs, there was an overall "hard" and annoying "edge" to the high frequencies. A kind of "mid-fi preamplifier" sound that simply turned me off. Actually, only on the single Chopin piano recording did the dynamics of the

CD make the overall playback enough better so that I liked the CD better overall musically than the record.

It was obvious that CDs made from analog tapes offer the worst of both worlds. The Sheffield Lab CD version of Amanda McBroom, *Growing up in Hollywood Town*, is a bad joke. The dynamic range of the CD was so bad I connected my scope to the output of the amplifier while comparing the CD to the original direct disc recording to confirm my ears. Sure enough, the peak transients were 6–9 dB less dynamic on the CD. The CD was much more compressed than the record and you got loud tape hiss on the CD as a bonus. Yetch! CDs made from tape recordings are not worth owning.

The Sony machine we examined was built with the same old phenolic boards and tiny trimmer pots that every other mid-fi builder uses – not satisfactory for long term stability, especially for digital logic circuitry. The audio output circuits looked like standard Japanese preamp designed. Most of the circuits are for trying to keep the laser in the right place. Definitely not a breakthrough in better design.

The bottom line, the CD is not, at this time, a “better” sound source. In fact, except for rare exceptions, it is a worse sound source. The dynamic range, low noise, and freedom from wear are nice, but I equal the dynamics on my best direct and digital records. The overall tonal balance is not improved over our record playback system (although I do suspect a CD will be better overall than many bad record players out there). And finally, I simply do not like the hardness in the sound I hear on every CD. It turns me off. I will not be buying or using a CD system in the near future. I suggest you can find better places for your audio dollars too.

*Frank Van Alstine*

### **VOLUME THREE NUMBER TEN OCTOBER, 1984**

You may have noticed that last month’s *Audio Basics* used a different type style. That was because it was done on a Coleco Adam computer and its built in word processing system. [1990 Note: You are lucky that you don’t see the Coleco Adam printing now as this whole mess has been reformatted – take my word for it, the Adam was pretty terrible.] That was a trial run on the Adam to see if it was a worthwhile unit for my kid’s use. The price was right (nearly free!) because my daughter would have quickly qualified for the \$500 college rebate offer on the Adam, and since the expansion package was only \$525 at local discount stores (we already had the basic Colecovision game)

the net price of the unit would have been just \$25.00 plus the interest on the \$500 over the next four years.

The unit had a lot of promise. Because the word processing was built into Read Only Memory instead of being on a disc, it ran very fast (for an 8-bit unit) and with excellent reliability and without the risk of wearing out floppies and crashing in the middle of things. The printer, although slow and very noisy, did a much better printing job than the typical dot matrix-stinter most home computers are stuck with. Even the modified cassette storage system was adequate for simply storing finished work for later retrieval. It didn’t have to be fast as you were not running from the cassette, all current programs and text were in fast internal electronic memory.

However, the unit as a whole still wasn’t worth our net \$25.00 cost! Too many bugs. It just would not do what it was documented to do. It drove us crazy isolating the bugs, and in each case, when informing Coleco of our distillation of various problems, the answer from them was, “Oh yes, we know about that, it won’t do that.” Swell! The least they could do in already knowing of a series of internal software or hardware flaws would be to publish a list of them so each individual user would not be faced with the task of reinventing the wheel and figuring out the operating defects all over again by himself.

In using the unit for two weeks we found the following major flaws: The printer spaces 5 half spaces when a command is given for 4 half spaces (using two full lines between paragraphs.) The memory only records 4 half spaces and forgets the extra half space. This completely screws up page endings as after several paragraphs, you end up with the printer returning many more lines than the computer has in memory. Forget about vertical reformatting, it cannot be done as documented. In horizontal reformatting, such as changing the margin settings on previously completed text, the unit simply goes berserk. Underlined words give it fits. The Adam randomly adds spaces between underlined words and then modifies its memory to store the mistakes permanently in the text when margins are changed. The unit also loses the spaces after words at the end of lines when the text is reformatted. If you retroactively reset the margins, words that had previously been at the end of lines are randomly run together and again, the data is lost from memory too, so the mistakes cannot be corrected by changing back to the original margin settings. In each case, contacting Coleco brought the response that they already knew about the problem, and they gave no help at all in suggesting cures. It appears they don’t really care about the system defects and have no plans for correcting the problems. These appear to be

problems with all units, not just our sample, and it appears there is no fix in sight. At that point we gave up and returned the unit. In explaining the problems to the computer store salesman (their demo unit behaved exactly as our sample) the response was, “Oh yes, we knew about that.” Thanks! Anyway, if a product does not do what it is documented to do it is not worth buying and who knows how many more flaws we would have turned up with more use, those above were enough for us. Coleco had better stick with Cabbage Patch dolls.

We have been seeing an inconsistency occurring recently regarding servicing of equipment. We are getting too many people calling claiming they have a defect in a piece of equipment, and that since it is a unit they hardly ever use (used in the garage system, up at the lake, or has been in storage and never used since they got it five years ago) that even though the equipment is long out of warranty, they should get free warranty service anyway, since the equipment never gets used and thus has hardly any time on it. Now the customer’s logic might have some merit, except, these demands for unilateral warranty extension are always followed with the further demand – “How fast will you fix it? I have got to have it back right away!” Interesting. If you are not using the equipment, why do you need expedited service? Our normal turnaround of three weeks is better than most, we believe, and we do put warranty work first in any event. If you do need it back instantly, then you must be using it all the time, which conflicts with your claim that it isn’t ever used. Which claim of yours should we believe?

A second service problem is the continuing return of equipment for service without prior authorization and without written data attached to the equipment describing the nature of the problem. Again, over half of the equipment returned for service has no problem at all (the last preamp returned with a claim “right channel out” simply had its balance control turned all the way to the left channel). We can resolve these kinds of problems for free with a telephone consultation before and instead of servicing the equipment. If you want low cost and best service, call us before returning equipment for repair.

Now for some good news. We have just put into production a nice improvement to the SUPER-FET series preamplifiers. We have changed Fet Integrated Circuits from National or Motorola LF356 type to a Texas Instrument TL071. The change was made for several reasons. We had a poor yield on National devices (only about 25% were quiet enough for our use) and Motorola has recently had production problems, delaying delivery on future orders for up to 46 weeks on this device. Thus we

ordered sample quantities of the TL071 and were pleasantly surprised with an outstanding yield (nearly every sample is very quiet) and found the new device gives better sonic performance to boot! We hear more powerful bass, better dynamic range, and purer highs using the TL071. The sonic improvements are noticeable and worthwhile. We are sorry to say we cannot give you a very good engineering reason for the sonic advantages of the TL071. It is very similar in concept to the LF356. It is a FET input op amp with high input impedance and low output impedance, high gain, low distortion, and a fast slew rate (all desirable characteristics and from an engineering specification standpoint, nearly identical to the specifications for the LF356). It is also pin out compatible and thus directly interchangeable in our circuits with the LF356. The only measurable difference is that the TL071 draws less than half the current of the LF356, thus, in effect, making the power supply capacitors "twice as big" and the supply stability even better yet (although our power supply is overkill in the first place). There are internal differences in the devices – they achieve the same (in theory) external results with somewhat different internal circuit designs. However, it is kind of difficult to document the internal distortion mechanisms of any given IC other than the linearity of the overall circuit it is used in. Since the circuit produces no distortion observable with conventional test equipment, the remaining small signal distortion effects of the op amp itself simply cannot be resolved with the equipment we have available now. Thus, our evaluations of the sonic quality of the op amp itself are limited to simply listening to the preamp.

The new tweeter retrofit for B&W 801, 802, 7/II and 17 models is not yet available for the U.S. market. Demand for new products has been high and B&W does not yet have the excess production reserves available to supply retrofit kits. They will be coming, the price will be reasonable, and they will be worthwhile. Of course all new production speaker systems do incorporate the new tweeters as standard.

I saw another of those interesting advertisements recently regarding the claim of high fidelity so good it cannot be told from live sound, this time from Klipsch. The claim was that the sound of a live piano player couldn't be told from a recording of that performance played back in the same room on a Klipsch speaker. These are not new claims, but they are interesting. I have experienced the same kind of performance test, put on by AR a few years ago at a trade show. They were making an A-B comparison of their loudspeakers with a small jazz group playing the same material live in the same room. The jazz band certainly did sound like AR speakers playing the same material! Is high fidelity (and

some loudspeaker brands) really that good now – so good you cannot tell it from live?

Nope!

You still cannot obtain reproduction equipment that is so good you cannot tell it from live.

You can, however, have a live group play so bad you cannot tell it from recorded.

All you have to do is have the live performers limit their dynamic range, mute their attacks, and compress their talent until they are duplicating the sound of the loudspeaker! This is not hard to do at all.

After AR finished their display, and after the audience was all done oohing and aahing, I simply walked up to the live group, picked up a drum stick, and rapped the cymbal once, hard – bang! Sorry folks, no audio component (including AR and Klipsch loudspeakers) could realistically reproduce that one simple dynamic cymbal strike.

So folks, remember the next time you see that "is it live or is it Memorex?", that they are asking the wrong question. First of all, in that studio, it isn't live versus Memorex at all – it is the sound of a live performer after being thrashed through some PA system versus a cassette tape thrashed through the same PA system – and in that case it is who cares versus who cares. And finally, Ella can sing to sound like Memorex a lot easier than Memorex can playback to sound like Ella.

A final "last word" on digital disc players (actually several final last words). The Magnavox 1000 disc player is now being advertised at \$219.00 in discount catalogues (it is probably as good as any for what that is worth). I ran out of space last month to explain why disc players all seem to have a hard, unnatural, and "edge" sound on highs and upper mid-range and why we cannot do anything yet about it.

The electronic problems are twofold. First, it appears that standard Japanese audio output stages are used, giving you the sonic quality of the typical "off-shore" receiver. That could be fixed if one could be assured a supply of a single brand and model of a disc player in large enough quantity so that the engineering and tooling costs of a new audio output board and related circuits could be written off over enough units built to make the unit cost rational and so that there would be a good chance of making a profit on the project. It appears that Meridian is remanufacturing the Magnavox 1000 on this basis. I assume they have worked a deal with Philips directly for the now widely discounted 1000 model and I hope they do well with it. However, since our business is mainly installing new circuit sets in customer supplied equipment, we could not begin to cost effectively tool new circuits to interface with all the various brands and models of disc players, nor can we be assured of a long term supply of any single model. Even

if we do a new output circuit that works better, of course it won't fit in the model disc player you own. We cannot win with this approach at this time.

Unfortunately, the audio output stages are not all of the problem. The real problem is underdamped high frequency resonances and terrible pulse response caused by high Q steep slope anti-aliasing filters. The filters are necessary to prevent information at greater than one half of the sampling rate (about 22 kHz) from being "translated" into output garbage at a frequency of the input frequency less half the sampling rate (30 kHz garbage in yields 8 kHz garbage out and while you may not be able to hear 30 kHz, you certainly can hear 8 kHz). The engineering problem is that one must have flat output to 20kHz and filter to have no output at 22 kHz. This cannot be done with a non-resonant filter. A damped filter needs much more bandwidth to work in than the 2 kHz available. The only solution with this slow sampling rate is an underdamped filter, which, no matter how you execute it, yields underdamped resonances and dynamic phase shifts throughout the upper audio range – the absolute enemy of good perceived music quality.

Our prediction is that the present digital audio disc format will fail. [1900 Note: Well - there goes another prediction doesn't it. Anyone got a spare crystal ball for sale?] It will not sell well enough to support the revitalization of mass market audio the way the off-shore importers hope because it is too expensive, source material is too expensive, and it simply is non-musical sounding. The alliance between all of the various competitive oriental suppliers will fall apart as they go back to the drawing boards to come up with a digital format that does work. In the near future 100 kHz or faster D to A converters will be available for as low a cost as the crude 44 kHz units are now. New formats will emerge that can be successfully filtered without any ringing or transient problems at all (if you have 50 or 100 kHz to work with you can filter with no problems at all) and units that actually play music will come to the market. They will be absolutely incompatible with the present format and DAD software. Your collection of non-musical 44 kHz sampling rate material will be obsolete and useless, along with your present seedy player. You will be screwed. The suppliers don't care, they have done it before and will do it to you again (still having fun with your SQ system, your AM-FM simulcast stereo system, your CD4 system, your Elcassette system, your discrete 4 channel system, etc.?).

Please understand that there is nothing wrong with digital encoding of source material. It is a great idea if properly executed. The present seedy system is a bad execution. It has uncureable technical problems. You will be left holding the bag (of obsolete discs) when (not if) it fails and is replaced by a system that works.

In our in house evaluation system, our Longhorn Grado gives us much better dynamic range, transparency, dimension, and sense of power and reality on any number of records (some dating back to the early 1950's) than the best of the seedy players. Thus we are somewhat surprised when a client complains about poor performance with a Longhorn Grado. One client, whose lament was "no bass or dynamics and edgy highs" and whose claim was the cartridge was absolutely perfectly set up recently went to the trouble of sending us his turntable and arm (no we don't recommend this) so we could see for ourselves that our cartridge was terrible. The unit was a Merrill modified AR turntable (a very thin layer of lead foil glued to the platter top (deadened things a little) and a new (nicely machined) T-Bar undercarriage designed to accept a Grace 707 arm instead of the original AR arm) (a nice try, but a properly set up original AR arm is much better than the Grace). The unit arrived in the trunk of a car, in a press fit grocery box, platter on, suspension unrestrained, after bouncing its way from Nebraska. The platter bearing survived (much to our amazement!). We did check the setup and condition of this system.

The cartridge was tracking at 3 grams, the anti-skate was adjusted as far off as possible with that arm (large excess outward side load) the cartridge overhang was 3/4 inch off, the entire base of the arm assembly was mechanically loose causing large dynamic slop in the system, the arm gimbals were misaligned, there were three broken headshell wires, and both the arm and platter bearing (dry) felt like they were running in a mixture of used road tar and sand. Yetch! Yes people, if you buy a set of NCT tires and set your wheel alignment 45° off, use the wrong size wheels, 5 pounds of air pressure, have worn out wheel bearings, and have the wheel balance a half-pound off, you will complain that the "tires don't handle well."

We spent a couple of hours and fixed things. The cartridge, which is very rugged, survived the abuse without damage at all. After a "lube job" with liquid silicon, careful adjustment and alignment of the cartridge, tightening to spec all fittings, and repairs to the wiring, the system sounds, tracks, and plays just fine (although without the superior "authority" of the original AR arm – the Grace arm is not rigid enough for optimum results). The system went from unlistenable to very good indeed. This brings up two final thoughts for this issue:

1. Your system will play no better than the worst component (or worst use of a component) in the playback chain. You can absolutely negate the entire value of your investment if you misuse any component in the chain or have a "weak link."
2. It is obvious the audiophile still needs more help in determining where the "weak link" is in his system. The trend is still to throw money at the wrong place, without curing

the real problem at all (such as buying subwoofers when the cartridge won't play bass).

3. You can be positive, if you cannot get a Longhorn Grado to track, or simply do not like the sound at all, that you have major flaws in the performance or setup of your record playback (turntable and tonearm) system.

Thus, next month, its time to tell you how to align a phono cartridge and get your record playback system to work well.

*Frank Van Alstine*

## VOLUME THREE NUMBER ELEVEN NOVEMBER, 1984

I received a letter this month, inquiring about rebuilding a PAS that also had a most reflective thought I would like to share with you. The owner said that he had used his Dyna PAS-3 preamp for many years in his system and that it had, "remained unmolested by time or me." Think about it the next time you start in with magic capacitors and Litz wire.

I need to correct a statement made last month regarding the output filters in Digital Disc Players. The filters are not actually anti-aliasing filters. Those filters are used in the recording process, ahead of the analog to digital converter in translating the analog source to an encoded digital master tape. The filters used in the disc player itself are more properly considered "smoothing filters" to eliminate the 44 kHz sampling signal from the output so that your preamp, amp, and tweeters are not fed a hard 44 kHz signal and melt. Thus it is probably not quite as critical that every bit of high frequency sampling signal be removed, as long as it is knocked down enough to cause no harm downstream, and not to interact with tape recorder bias signals causing distortion when making tapes. They serve much the same function as the multiplex filters in an FM tuner. Since it is possible to design an after the fact filter that does not sound terrible (we have done so in the Super Tuner Two) it might also be possible to design a digital disc player filter that does not ring like crazy. We are still faced with the problem of a fluid market and no single source of a disc player that has the potential of being on the market long enough and used by enough people to make an output section redesign an economically practical endeavor. Thus, although I still am not happy with the hard sound I have heard on every disc player I have evaluated so far, I am premature to condemn them all as a class. I cannot really know why the samples I have heard sound unmusical to me. Certainly the recording process, properly executed, is not inherently unmusical as many digitally encoded source records (such as most Telarc's) sound just fine to me. Am I inconsistent in my subjective evaluation? Perhaps. Obviously, the average disc player is better than 90% of the record playing setups out there

but they still do not approach the musical quality of a properly set up and working record system. Thus a better bit of advice might be to tell you that if you like a disc player better than your record player, your record player is not working well at all. We will try to help you with that later in this issue.

We have a great Christmas present suggestion for you. It seems like B&W is on a real "hitting streak" turning out one great new product after another. Their newest loudspeaker, the just introduced DM 100, may be the best value of all, and they are only \$220 per pair!

The DM 100 is a small bookshelf system, about 14.5" high, 9" wide, and 9" deep. It is a two way system, using the great new tweeter as in the rest of the line, and a polymer damped 150 mm (6") woofer with a cast frame. It is an attractive package with a quality vinyl finish on all sides, heavy five way binding post inputs, and a black cloth grill. It would, however, still be just another low priced little loudspeaker if it just sounded like other good little speakers. It does not. It sounds like a fine, very high definition, big speaker system. It is very neutral, has no "box" sound at all, and plays much bigger than it has any right to. It is simply outrageous! It is quite efficient, but published data on the exact efficiency is still not available (B&W gets the new products perfected before they get the paperwork done.) Compared to the Mission 70 Mark II discussed here a few months ago, the DM 100 plays bigger, more dynamically, over a greater range, and with greater resolution. It wins in every respect and that was a most difficult achievement as the Mission is very good indeed. The bass response is much better than the cabinet size or woofer size would lead you to expect. I believe it is because the bass it plays is so incredibly clean (no boom or mud at all) that you can hear the bass so clearly that you get the feeling of deeper bass than the unit actually plays and it is what you hear that is important.

The DM 100 comes as a matched pair (as do all B&W loudspeakers) and the imaging is outstanding (perhaps more than outstanding!). It is easily the best small loudspeaker system we have yet heard at any price.

Do you need loudspeakers for a second system and don't want to give up any quality at all? Get the DM 100. Do you want to treat a child to a real music system without breaking your budget? Get the DM 100. Are you running a satellite – subwoofer system? Replace your satellites with the DM 100. B&W has honestly redefined what a low priced and small loudspeaker system can do. At \$220 per pair, they are going to sell jillions of them.

We have one of the first demo sets to come into the United States. We are promised more in about three weeks, in time to deliver them to you by Christmas if you order now. The \$220 a pair price includes shipping to you in the continental U.S.A. if you order them from us. Obviously, if your

local B&W dealer has them, get them from him now, as supplies will be short for a while. This product has really surprised us and it will pleasantly surprise you too.

Note, a few of you who have never heard a current B&W loudspeaker have complained that we must just be reviewing them because we sell them, and do not believe us and will not go out and listen to them at all! Sorry folks, B&W is building the best line of loudspeakers in the world. Please understand that our creditability is on the line! If we recommend that you buy a “dog” just because we sell it, you will not trust anything we advise you about in the future and we will lose you as a potential customer for any product we build or sell. We are not that stupid. Note that there are some B&W models we are not enthused about (the DM17, the LM1, and the 802, for example) and we will tell you so. We will also tell you about equipment we like that we do not sell at all, such as Mission and NAD. I will not recommend a product that I would be unhappy with running in my own system. To the extent that we have shown in *Audio Basics* that we can make consistently good value judgments, believe us!

We had an interesting visit here a couple of weeks ago. The Hafler factory representative for this territory stopped by to check us out and see what we were doing with Hafler products. We showed him our products, told him about our circuits in detail, showed him our circuit boards, our layouts, our workmanship, and played the products for him. We explained that we considered stock Hafler units to be good value on the open market (excellent value for the kit builder). We explained that the limitations of the stock Hafler units was that as a design to be built as a kit, the manufacturer knew he had no control over the finished workmanship and layout done by the end user. The designer knew that some units would be built with very poor workmanship. Thus the designs had to be engineered so that they would still have a very good chance of working reliably even if the inside layout looked like a rat’s nest. This means, of course, that the fastest possible circuits cannot be used, for they would be sure to turn into fast oscillators if bad layout workmanship was used (with output and input leads near each other for example). Hafler first has to protect the kit builder from himself before designing the last “erg” of performance into the unit. We told the Hafler factory representative that in spite of these design constraints, that Hafler had designed and produced kit units about as well as they can possibly be done, and that they were certainly better designed, more reliable, and better sounding than almost all other stock esoteric equipment, price not being an object. We then explained that it was possible to build a better performing circuit than the stock Hafler units, but not as a kit design. There was no point trying to reinvent that wheel. To execute a better circuit, the designer had to have complete control

of all aspects, including finished layout and workmanship. Thus, we did not offer our solid state audio circuits as do-it-yourself kits. We do control every step of our designs, and only by doing this can we achieve unconditional stability and better audio performance too.

I think the Hafler representative was impressed! Actually, I know so because his response was to urge us to become a franchised Hafler dealer ourselves! He suggested that we are indeed doing good work that complements the original Hafler designs and goals, not running them down in order to make ourselves look good. He also suggested that we could offer better value to our customers by purchasing Hafler units directly from the factory rather than having to deal with intermediate sources. For example, most stock Hafler kits have recently had a price increase. If we can lower our cost by buying direct, we will not have to raise our prices at all. He also suggested that we should be selling stock Hafler units to those that cannot afford or do not desire our higher performance (but more expensive) circuits. After thinking about it, we decided the rep was right and we have indeed applied for (and expect to get) a factory direct Hafler franchise. We will indeed offer the stock Hafler units (either kit or wired) to those of you who appreciate their good value. When we have the line available we will certainly let you know.

Some time back, I mentioned that I had visited Music West in Laramie, Wyoming while on a trip and that I thought it was one of the nicest and best run audio stores I had ever seen. I just got a letter from the owner that I need to pass along to you. Andy says, “Dear Frank, We sold Music West on July 3rd and me and my family moved back to California. The economy in Wyoming was getting to be very bad, and certainly no place for a “high end” or even “quality” dealer. I am now back to the “hobby” mode of Hi Fi and have taken a position with Jet Propulsion Laboratory. So much for owning my own small business. I am glad to be out of retail – hopefully for ever! You might mention to your readers – this is what happens when you do not support someone who really, really cares, like some local small, independent dealers.”

Andy is correct, and without your support, there is no way you will have the local expert help to enable you to own a quality audio system – you will just be stuck with the department store stuff and department store advice.

We have recently been evaluating some toroid power transformer samples with interesting results. We have confirmed they do have some real advantages (but also some real disadvantages!).

One advantage is that toroids are available in single lot quantity directly from two U.S. sources and can be used for replacements in amplifiers such as the Dyna St-120 or St-150 in the rare event of an original power transformer failure. We suggest you write to Gladstone Electronics,

1585 Kenmore Avenue, Buffalo, New York 14217 and/or Toroid Corporation of Maryland, 6000 Laurel-Bowie Road, Bowie, Maryland 20715-4037 for their catalogues of off the shelf toroid power transformers. Feel free to call us (do not write as we just do not have time to answer technical letters regarding individual system problems) regarding the specifications for a toroid power transformer that will be suitable for your particular application. Vacuum tube equipment owners, sorry, but I am not aware of any toroids useful for vacuum tube equipment.

To backtrack a bit, toroid power transformers are very different in appearance than the conventional “chunk of iron” power transformers you are used to seeing in most equipment. The iron core is essentially a long strip of steel, wound into a ring (much like a wound up clock spring). The primary winding is wound around the ring (at right angles to the ring) and the secondary winding is then placed over the primary – the final product looking somewhat like a fat doughnut.

The electrical advantages of a toroid are: 1.) Higher efficiency – there is better magnetic coupling between the primary and secondary windings than in a conventional transformer. This efficiency can be used two ways. A. The same current rating can be obtained with a lighter and smaller (and hopefully less expensive) transformer, thus saving manufacturing and shipping costs, and lowering the price of the end product to the consumer, all other things being equal. B. A higher current and tighter regulating transformer can be used of equal weight (subject to the constraints of the bulk of the toroid and its hard to fit circular shape) perhaps improving the performance of the product at no additional cost to the end user. 2.) Less external hum fields. The toroid shape core is more efficient and contains the electromagnetic fields better. This means (all other things being equal) that less electromagnetic trash is radiated into the associated circuits, resulting in quieter operation of the unit. This advantage can also be used to make the finished product smaller, as the toroid transformer can be located closer to the audio circuits without risking excess output hum. 3.) It is easy to add an additional winding to a toroid (simply a few more turns around what is already there) to custom make a transformer with additional taps for special purpose applications. This can help make a sophisticated new design, needing several different operating voltages, much less expensive to execute.

However, there ain’t no such thing as a free lunch. The toroid does have several disadvantages. The major disadvantage is poor heat dissipation. The iron core of a toroid is on the inside insulated from free air by all of the primary and secondary windings and associated insulation. Thus much greater care must be used with a toroid to prevent excess heat build up and catastrophic failure! A conventional power transformer has the iron on the outside where heat can easily escape. It is

critical for the designer using a toroid to insure the transformer is used well within its design rating to avoid overheating, you simply cannot “get by” with an underrated unit running hot as you can with conventional designs. A case in point is the ILP 625 VA transformer used in the Hafler DH-200 and DH-220 modifications by Musical Concepts. This transformer has a 7 ampere rating. The Hafler amplifiers require 8 amps of current at full 8 ohm power (4 amps per channel) and greater current yet into lower impedance loads. The current demands of the circuits are in excess of the toroid’s continuous rating! Although the transformer in and of itself is just fine, we think that Musical Concepts has misapplied its use, that one should not use a 7 amp device in a circuit that draws more than 7 amps. We suspect that sustained full power will overheat and cause the toroid to fail. The 625 VA unit is just fine in a 50 watt rated amplifier, but for 100+ watt safe operation, a custom made toroid of about 12 ampere continuous rating is called for. Although the stock Hafler transformer does exhibit some voltage drop at full power, and will get quite warm at sustained full power, it is operating within its design limits and will support full power of the amplifier (even with our internal circuit set). Musical Concepts might be doing you a favor by supplying a toroid, but only if they would supply the proper current rating toroid for the application (which would be much bigger and more expensive). In this case, we do not think they are doing you any favors at all. Note, for our circuit sets, we do require the original Hafler power transformer as we will not put an amplifier out with an underrated and overstressed power transformer.

A further toroid problem might be excess mechanical hum. So far, we are battling two out of two on ILP toroid samples with more mechanical hum (loose core windings?) than desirable. In theory, a toroid should be very quiet, perhaps we are just having bad luck with our samples, we will try again.

We are not planning to use toroid transformers in our circuit rebuilds for economic reasons. Each unit comes with a satisfactory standard transformer. To install a toroid would mean you are now paying for two transformers, the original and the replacement toroid. We would have to charge you from \$70 to \$100 extra and the slight power advantages gained would simply not be worth the extra cost. In considering future new designs, we will think about toroids. We would be able (all other things being equal) to make the units smaller and lighter with no adverse effects, and because of less full power voltage drop, make somewhat higher power with no increase in idle voltage or currents. Right now, however, our only application for toroids will be to have as a backup source of spares if you have a chassis to rebuild but with a defective original power transformer. For example, the Gladstone (ILP) 9A018 toroid (which will cost you about \$70.00 direct from Gladstone) will work just fine in the Stereo Cost Cutters

Dyna St-150 chassis kit (\$69.00 direct from Stereo Cost Cutters and missing the power transformer and trim pieces). If you supply us with both, we can build in the MOS-FET 150B circuits for the usual \$300.00. The finished product will not have faceplate trim, and this is assuming that SCC does supply all the necessary hardware (power switch, diode bridge, filter caps, etc.). We will charge extra for missing hardware and cannot supply trim and faceplate parts. In this case, you are not paying for the original power transformer and so the extra work you go through to acquire the ILP toroid will be worth the effort.

O.K. folks, now it is time to teach you how to set up a phono cartridge for proper operation in your turntable. Using a phono cartridge with a random or “eyeball” installation is analogous to buying a new set of Pirelli P7 tires and then randomly changing all front end adjustments on your car, and randomly adding wheel balance weights on your old set of out of true and out of round wheels, and then wondering why the car doesn’t track, doesn’t handle well, and why the tires are wearing rapidly and unevenly. The problem out there is that bad! We got one Longhorn Grado back because the user couldn’t even connect the headshell wires to it in the right order – after miswiring it, the user claimed “it only played mono” and returned it. We get setups back to fix with “it doesn’t image good” complaints when the cartridge is wired with the channels out of phase. We get turntables back to fix because “the arm goes up, not down” with the tracking pressure set at negative grams. We get complaints of “rapid wear” with arms set to track at 15 grams. Some people tighten the hardware with a pipe wrench (I think) actually breaking the cartridge body in half. And, of course, there are those who attempt to solder the leads to the cartridge pins, melting the internal coil wires in the process every time. The major manufacturers have essentially given up trying to teach salesmen and customers how to properly mount and adjust a phono cartridge and have instead gone to P Mount assemblies. In this plug in system, you cannot install it wrong, but, unfortunately, you cannot get it exactly right either. And, since the cartridge becomes a structural part of the arm (a task it does not perform well), all P Mount setups we have examined have had excess arm resonances and overall unsatisfactory sonic performance. The P Mount system is only useful to allow a discount store salesman to get a phono cartridge in right side up (hopefully) in 15 seconds and get you out of the store with your stack of boxes quickly so he can go on to the next midnight madness customer or to go back to his comic book or card game.

Anyway, first you need to know the meanings of the following terms we will use in describing proper cartridge alignment.

**OVERHANG.** The distance from the arm pivot point (point of rotation of the tone arm) to the stylus tip. For any given tonearm, there exists one, and only one, effective OVERHANG length

that will allow the arm to most closely duplicate the path traveled by the cutting stylus that produced the record groove in the first place.

**OFFSET ANGLE.** The angular relationship between the tone arm and the cartridge body. The cartridge is never mounted in a straight line relationship with the arm tube. All tonearms have a built in offset angle so that the cartridge body is, in effect, “turned in” in relation to the arm tube. This “turn in” or offset angle is partially built into the tone arm and/or headshell. However, most tonearms do not have a correct offset angle designed in. In most setups, it will be necessary to increase the offset angle by mounting the cartridge “crooked” in the headshell, with, usually, the cartridge turned in further. In 1941, H. G. Baerwald published a thorough analysis of the mathematics and geometry of cartridge offset angle relationships with tonearms to achieve ideal tracking conditions. His absolutely correct analysis has been essentially ignored by the major manufacturers for the past 40 years (cartridge and tonearm designers have all flunked 9th grade geometry class?). He proved that there is one, and only one, correct offset angle for any given tonearm length and pivot location that, in connection with the one, and only one, correct overhang length mentioned above, will yield optimum playback duplication of the record cutter.

**VERTICAL TRACKING ANGLE (VTA).** The vertical relationship between the stylus tip and the record. When the record is cut, the cutter stylus is not set at right angles (straight up and down) to the record surface. The tip of the cutter stylus “leads” for technical reasons to enable the cutter to make a “clean” cut into the blank master record surface. The angle the cutter stylus deviates from straight up and down is the VTA, and is approximately 15°. It is very important for the stylus assembly in your cartridge to very closely duplicate this “tip lead” angle for proper tracking of the record groove. Thus your Vertical Tracking Angle must be carefully adjusted by either raising or lowering the tonearm assembly (if that adjustment is available) or by shimming the cartridge in the headshell to raise or lower the front or back of the cartridge, as appropriate for the installation, to achieve the proper VTA.

**HORIZONTAL ALIGNMENT.** Facing the front of the cartridge – arm assembly and looking straight towards the front end, the cartridge must be at right angles to the record surface – not tipped sideways one way or the other. This Horizontal Alignment can be adjusted by loosening and adjusting the headshell or arm tube in some installations, or by careful use of shims under one side of the cartridge or the other in tonearms without that adjustment capability. We have seen some units in which this adjustment was made with a large pipe wrench tapped lightly with a sledge hammer (NOT RECOMMENDED!).

The four adjustments mentioned above (when we finish telling you how to make them) essen-

tially locate the cartridge and rotate it in space (in roll, yaw, and pitch) so that the stylus tip meets the record groove at exactly the right set of angles, and at exactly the right place to accurately retrieve the information on the groove. Unless these adjustments are set properly, your cartridge will work just as well as the Pirelli P7 tires mentioned earlier. There are, however, more adjustments needed, defined as follows:

**TRACKING FORCE.** The force of the tip of the stylus against the record, being the mass times the acceleration which, on the surface of the earth, is 32 ft/sec<sup>2</sup>. The acceleration can be achieved by an appropriate spring, by unbalancing the tonearm around its pivot, or by a combination of both effects. This force is measured with a tracking force gauge which can be either spring loaded or a balance beam in itself. Note that gravitational acceleration varies with location. If the tracking force was set, and measured, only with a spring system, then the turntable set up properly on the earth would measure the same, and actually have the same (and correct) tracking force if used in a lower gravitational field (on the surface of the Moon, for example). If the setup is made with an unbalanced weight method (adjusting a counterweight on the back of the arm) then the tracking force would be low in a lesser gravitational field. Note – the tracking force has nothing to do with the actual mass of the entire tonearm – cartridge as a whole. A 10 ton tonearm can be set to track with a 1/2 gram tracking force, given appropriate springs and/or counterbalances. Inertial reaction to record warp would not be so wonderful, but that is another aspect of the setup completely. In general, if the cartridge is set with too high a tracking force, this will cause excess record and tip wear, and cause premature failure of the cartridge suspension. If the tracking force is set too low, the tip will break contact with the groove (violently) causing excess record and tip wear, and shattering harsh sound. In addition, improper tracking force (either too high or too low) will mislocate the cartridge sensor-coil system in its magnetic field, causing excess distortion due to asymmetrical magnetic interaction and poor, unbalanced, and undynamic playback quality.

**ANTI-SKATE.** A force applied to the side of the stylus to balance it horizontally in the record groove. Given the dynamics of the turning record and a pivoted tonearm, there exists a force that tends to pull the arm in towards the center of the record. This force “loads” the inside edge of the diamond stylus heavier than the outside edge. The tracking force is effectively uneven, being heavier than set on the inside of the diamond edge and lighter than set on the outside. This “skating” force also tends to pull the stylus inward, out of alignment with the cartridge body, again disturbing the magnetic relationships of the stylus and the body mounted coils and/or magnets. The inward deformation caused by uncorrected skating forces can also (besides distorting the sound) cause permanent deformation of the stylus as-

sembly, effectively destroying your cartridge. This “skating” force must be opposed with a properly set ANTI-SKATE force, which applies an opposing force outward on the assembly, to properly balance the diamond in the record groove.

Now, before we start telling you how to make the necessary adjustments, we must first tell you to acquire the necessary tools and gauges. Just as you cannot align the front end of your Porsche to use those Pirelli P7 tires properly without proper alignment equipment, you cannot set up your phono cartridge alignment without adequate tools. You must have the following:

**TRACKING FORCE GAUGE.** The “built-in” gauges in most tonearms are hopelessly inaccurate. Purchase a quality independent stylus tracking force gauge. The AR plastic balance gauge and the Shure balance gauge both work fine and should be available at local dealers.

**OVERHANG and OFFSET ANGLE ALIGNMENT GAUGE.** These are devices that allow easy adjustment of these parameters in accordance with Baerwald’s mathematics. The Dennesen Soundtractor, the Cart-align, and the Mobile Fidelity Geodisc will all give accurate and repeatable results. You must own one of these gauges to set up a cartridge properly. Buy one now to follow our advice to be continued next month. Note that the paper, cardboard, or plastic gauges supplied with your turntable are, in general, not accurate at all, and are not in accordance with Baerwald. An exception is the gauges supplied with current Harman-Kardon turntables, which are, if properly used, accurate.

**BLANK DISC (grooveless record)** for adjusting ANTI-SKATE. Although there are some test records with blank sections, and the back side of some demo records are blank and useful, your best choice is to have a glass shop (window repair shop) make you a blank record out of thin plexiglass cut the size of a record with the appropriate hole in the middle. This will allow you to see the effects of skating, and proper anti-skating adjustments across the entire swing of the arm from outside edge of the record to inside edge. Again, the built in anti-skate gauges in your tonearm are not accurate.

**JEWELERS SCREWDRIVER SET, NEEDLE NOSE PLIERS, MINIATURE ALLEN WRENCH SET.** You cannot make the necessary adjustments with a kitchen knife and a rusty Vise-grip. These tools are readily available at low cost from Sears, Wards, or many other sources.

Get your tools and gauges rounded up, and next month we will tell you how to use them to make your turntable, arm, and cartridge work well.

Hot Flash! Hafler has acquired Acoustat!

*Frank Van Alstine*

## VOLUME THREE NUMBER TWELVE DECEMBER, 1984

Merry Christmas! You have helped us have a very good year, and we hope your year was good too, and that next year will be even better yet. Thank you for your support and many kind letters of encouragement.

Good news for Acoustat owners! Acoustat is back in business again as an independent subdivision of the David Hafler Company, who acquired them last month. Hafler will take care of all warranty obligations. Acoustat will continue with continue with same distribution and dealer network as now exists, but with Hafler’s backing, will be able to provide better customer and dealer response. Acoustat distribution will be independent of the Hafler products dealer network. You can contact Acoustat at the same Ft. Lauderdale telephone number and address as before. Production of all products is resuming.

Hafler is also announcing a major product improvement for the Acoustat electrostatic loudspeakers, a new, and I am told, much improved interface transformer set. This new Medallion Transformer was developed by Acoustat just before the company went bankrupt and production is beginning immediately under the new Hafler Company direction. Early feedback from reviewers is favorable, according to a Hafler sales manager (I have not heard it yet, myself). This improved interface is available as a retrofit for previous Acoustat customers. The cost is \$300.00 for full range speakers, and \$225.00 for sub-woofer models. The customer pays shipping of the interface both ways, and return authorization is required! There is a waiting list! Both the high frequency and low frequency transformers will be replaced in this factory installed retrofit. Owners will be contacted through their warranty cards, but we suggest you write Acoustat directly if interested. We have also been informed that Jim Strickland, the innovator behind Acoustat’s interesting products, will remain with the company as chief design and product development engineer, which is very good news. We are very please to see Acoustat “rescued.” They make products that deserve your consideration.

Our Hafler franchise has been approved and soon we will have stock Hafler products available for you kit builders as a compliment to our custom product line. Give us another thirty days to get a new catalogue prepared. We do not plan on handling Acoustat for now, we just do not have room to display the loudspeakers effectively.

I am still trying to find a replacement for my IBM 75 electronic typewriter which is getting a bit creaky after six years of solid use, and does not have a non-volatile memory, which means when the power goes off here (as it did last night after I had four pages of *Audio Basics* in memory but not proofed or as final copy yet) the whole shebang is lost in space – poof! – and I get to start

typing all over again. Murphy says the more you have stored in memory, the more likely you are to have a power outage, and as usual, Murphy is right. Anyway, this issue of *Audio Basics* is being composed on a clever little electronic typewriter I bought my daughter for her birthday, a Sharp PA-1000. This battery powered machine (with AC adaptor) cost just \$239.00 at K-Mart plus \$49.00 for an extended eight page internal non-volatile memory (when power fails, memory remains, for up to a year! So there, Murphy! The operating system works bug-free and it will do neat things like bold face type and continuous underlining. It is very quiet, has a nice feeling keyboard, an easy to learn instruction manual, prints 20 characters a second, and has a full eighty character display which allows useful editing and corrections of typos before the text is printed. You can also go back through a composed text without printing it out and edit, add text, delete text, and reformat before printing out the final corrected (and hopefully perfect) copy. It has more memory, a better keyboard, and a more useful display than the Canon and Brother machines in this price range and so far is working perfectly. My daughter even used it to type out a theme while riding in the car on the 120 mile trip to Grandma's house for Thanksgiving. If you are still looking for a useful last minute Christmas present for a high school or college age kid, I cannot think of anything better. The only thing it will not do that I need is to handle multiple page carbons (such as airbills). The thermal printer is limited to single sheet typing. Best print quality is with thermal paper such as I am now using, and without the carbon film ribbon. It will however, work on plain paper with its thermal transfer ribbon, but with slightly poorer resolution. When you consider that \$200 - \$300 only bought a simple mechanical portable typewriter a few years ago, with no storage, correction, or editing capability at all, and that an electronic word processor with text editing capability was the size of a grand piano and cost \$20,000 in the early 1970s, progress is being made by clever engineers.

In fact, consider in general that our main defense against inflation, dollar devaluation, and possible economic collapse is the fact that competent producers have been (and will continue to be) producing faster and better than the government can tax, restrict, and inflate. All the gloom predictors (those claiming economic collapse, depression, and \$3000 an ounce gold coming in the near future) have failed to factor into their projections the ability of industrious people to produce more than they consume and to outproduce the nearly bottomless ability of governments to tax and take. I am an optimist dear readers, I think we will win and continue winning. If I did not project so, I would not project so, I would not be producing, I would be hoarding and hiding. We are not going to run out of energy, food, or space; those that think so just do not understand the human ability of achievement and do not factor in progress, or

the real rate of future progress (much greater than projected by nearly all planners) in their projections. Keep producing people, and you will have a happy New Year!

#### **Now, on to our main topic, How to make your turntable and phono cartridge work.**

You will need a clear work space, good light, the tools and alignment guide we mentioned last month, and methyl alcohol (available through a drug store) for cleaning the belts and/or drive wheels and pulleys. Find your turntable and tone arm owners manuals too (or write to the manufacturer for another copy) as it difficult to disassemble the unit enough to clean and adjust it without adequate data. Your unit must be in good working order as it is useless to carefully align a cartridge in a defective turntable/arm. Adjustments will not cure worn belts, bent pulley shafts, scored bearings, open arm wiring, missing ground wires, bent tone arms, and/or sagged turntable suspensions. Now is a good time to consider the age and condition of your present cartridge too. Cartridges age, even if not used much. The magnets gradually lose strength, the elastic suspensions slowly harden, and diamonds wear. The sonic quality may slowly slip away without your noticing it much. In general, if your present cartridge is over two years old, you should consider replacing the whole thing, rather than just buying a replacement stylus assembly. The state of the art of phono cartridge design has been improving rapidly, and it is likely that a new cartridge costing no more than the price of a replacement stylus for your old one will outplay your old cartridge. It appears that moving coil cartridges, in general, age much faster than conventional (and much less expensive) normal cartridges. Their compliance is less and tracking forces are higher in the first place, many have foam suspensions that simply become brittle and powder away, and of course you cannot replace the stylus yourself at a rational price. Underground magazines report service life as short as 90 days for high priced moving coil cartridges. If yours is over a year old, now is the time to think about replacing it with something rational.

Assuming your turntable/arm are in good working order, now is the time to do some maintenance. Clean the drive belt, pulley, platter where the belt or drive wheel rides, and any belt guides with methyl alcohol. If your platter removes, clean the main bearing well and spindle and relubricate with Mobil Delvac 1 5W-40 synthetic motor oil (by far the best stuff we have found for your car engine too, including turbos and diesels). Only a few drops do it for most turntables. Caution! If your turntable has plastic parts in the bearing assembly (Linn Sondek and a few others) use only the manufacturer's recommended lubricants. Again, read your owner's manual! Check your bearings closely for wear and scoring. If the bearing well is scratched or if you get metal particles out along with the old oil, your unit may be due for replacement. We suggest that our

rebuilt Harman-Kardon T-25 package will outplay anything you have run across at any price, and at \$325 for the complete package, delivered in the USA, it may be less expensive than repairs to esoteric units. If you are using a direct drive turntable there is not much you can do to maintain it. With the platter running, rest your fingertips very lightly against the base side or top. If you can feel the unit trembling at all, you own a rather useless "shaker table" rather than a turntable and it should be replaced as it never will sound clean. Note that a direct drive turntable has its motor built into the platter. In addition, the magnetic fields of the motor surround the main bearing, attracting metallic particles into the bearing assembly.

We cannot think of a more stupid way to design a turntable! Setting your record and cartridge onto a running motor with rapid bearing wear is not our idea of how to have good playback performance. Refer back to the March and April, 1984, issues of *Audio Basics* for data and a source for the Dow Corning 200 fluid (liquid silicon) we use for tone arm bearing lubrication. A drop or two of 1000 centistroke Dow Corning 200 fluid into the bearing pivots of any tonearm will substantially reduce friction and resonances. A small hypodermic needle is very useful for getting the stuff into the right places.

If your turntable does need repairs, and if you need to transport it, now is the time to relearn how to transport it without damaging it. You must remove the platter and reinstall any suspension and/or motor lockdown and transport screws. Do not trust arm locks either, tie the tonearm down with a twist tie. More turntables are damaged by being bounced around in the car (damaging main bearings and suspensions) than by any other reason. Of course, if you are going to install a new cartridge or stylus, make all of your maintenance tests with the old cartridge as there is no point risking damage to the new one. A not uncommon problem with turntables with a switch controlled speed change and servo-drive is dirty contacts at the switch. Since the switch is part of the speed control circuit, a dirty contact can cause the turntable speed to run away. We have seen this happen on several Technics units. The cure is simple, a shot of Cramolin Red Spray (available from us for \$15.00 per can) into the switch contacts, and a few cycles of the switch to clean its contacts. Once you are sure your unit is working at its best and is worth continued use, it is time to get the cartridge set up properly.

If you have a tonearm with a removable headshell, remove the headshell containing the old cartridge for examination, cleaning, and adjustment. If your tonearm does not have a removable headshell, you have three choices: 1. stand on your head to remove, install, and adjust the cartridge; 2. do it with mirrors; 3. remove the entire tone arm so that you can work on it rationally. We suggest you remove the tonearm. Almost always,

the units we see here have loose or misadjusted settings so the chances are you will not be losing any useful previous adjustment. Note that it is not necessary or desirable to remove the complete arm assembly, mounting base, cueing control, wiring and all. With almost all separate tonearms, the connection cables unplug from the bottom, and the basic arm assembly slides up and out of its mounting assembly after unlocking one or more set screws (as usual, refer to your owner's manual). When you remove your old cartridge, first slide off the headshell wires from the cartridge pins (noting the color code as follows: RED = RIGHT CHANNEL HOT, GREEN = RIGHT CHANNEL GROUND, WHITE = LEFT CHANNEL HOT, and BLUE OR BLACK = LEFT CHANNEL GROUND). It is not unusual for these leads to be installed wrong, causing out of phase or reversed channel or mono performance (we had one Longhorn Grado returned for a refund for this reason - the user screwed up the headshell wiring and then claimed the cartridge only played mono - an absolute case of user incompetence). If the headshell wires have been previously repaired or replaced, we advise you use an ohmmeter to check them out. Obviously, you should have continuity from the tips of the RCA phono plugs (hot) to the red and white headshell wires on the right and left channels, and from the outer portion of the plugs to the green and blue/black wires. None of the leads should be shorted together or cross-wired. If you are getting a "dropout" while the arm is moving across the record, or when you touch or move the arm, you likely have a shorted or open wire inside the tonearm (likely at the pivot). If so, replace the tonearm or have the manufacturer repair it. There is no good way for a user to replace the internal arm wiring. Observe if the clips on the end of the headshell leads fit the cartridge pins snugly or can touch each other. Loose clips, bad solder connections between the clips and leads, and clips too big for the cartridge pin spacing that contact each other are also likely causes for channel dropouts. (In general, if a hot lead is open or shorted to the ground lead, the result will be no sound from that channel at all. If the ground lead is open the result will be lots of loud hum). Do not make any solder connections to the cartridge pins themselves or to the headshell clips while they are connected to the cartridge clips as this will always ruin the cartridge!

Remove the old cartridge and save the mounting hardware! This is especially true for Thorens and original AR units where only the hardware supplied with the turntable will fit the headshell! We see many Thorens turntables for cartridge installation. We believe the first instruction in the owner's manual must be "throw away all accessories and extra cartridge mounting hardware!" as we have yet to find an owner that still has them available. Your turntable will work a lot better if you do not throw away some of its parts! We cannot imagine an automobile owner first throw-

ing away his jack, spare tire, oil dipstick, oil filler cap, hubcaps, and spare keys before putting the car into service, and returning it for service by dragging it along on its roof! Yet this is how turntable owners seem to treat their products time after time. No wonder why hard sounding digital disc players are becoming popular, the owner cannot do much to them to screw them up (can't do much to them to make them sound really good either). If you have a P-MOUNT tonearm, the kind with no headshell wires at all, the cartridge just plugs into the end of the arm tube, the "adjustments" are very simple and as follows: pick up turntable, open garbage can, drop in, close lid, go buy a Sony D-5 disc player (less than \$300). P-Mount arms cannot be set up properly and will not accept quality phono cartridges, they do not perform as well as a compact disc player, thus there is no point in messing with them at all.

Anyway, assuming you are still salvaging your turntable, check the pin size of your old cartridge against your new cartridge. If the pins for your new cartridge are smaller, you will have to gently squeeze the headshell wire clips to get a tight fit on the new pins. A little Cramolin will clean the oxidation from the clips too. If possible, install the new cartridge with the stylus guard on to avoid damaging the stylus. In any event, save the stylus guard for future use. Use metal mounting screws and nuts (not plastic which does not provide a firm interface between the cartridge and headshell). If possible, install the cartridge flush against the headshell without using shims, spacers, or other accessories (which tend to form tuned resonant cavities under the cartridge and cause non-musical colorations). Do not tighten the hardware firmly at this time, as it will be necessary to move the cartridge around in the headshell during the alignment process. Now it is necessary to reinstall the headshell or tonearm and rebalance the tonearm to achieve a crude balance of about one gram to avoid damaging the stylus while making the rest of the adjustments.

In general, tonearms are balanced by using the following procedure:

1. Set the stylus force to zero, if the tonearm has a stylus force applying mechanism (see your owner's manual). If there is no stylus force dial or indicator built into the arm or turntable, you must have an accessory stylus force gauge as mentioned last month, and it is a good idea to have one in any event.
2. Set any anti-skate adjustment to zero (noting first its original setting) because it is difficult to balance the tonearm while the anti-skate is pulling it sideways.
3. Now (with the turntable unplugged and off) balance the tonearm so that the arm "floats" going neither up or down. This is usually achieved by adjusting the counterweight on the back of the arm in or out. This "calibrates" the tonearm with the mass of the cartridge in

use at a true "0 gram" balance. Now rotate the indicator dial on the counterweight (most cases) to read "0 grams" without disturbing the overall "floating" balance. Now an actual 0 grams equals a "0 gram" reading on your tonearm gauge with this particular cartridge. If you change cartridges, this procedure must be repeated as each cartridge has a different mass and the tonearm must be recalibrated for each new cartridge. If your tonearm has an electronically adjusted balance, follow the instructions in your owner's manual. Now dial in one gram of tracking pressure. Although this may be too little for final use, it is adequate to make later adjustments without risking stylus damage.

Now put a blank disc or old record you don't mind scratching on the turntable. This will be used for making a visual check of these following adjustments:

1. VTA (vertical tracking angle). In general the top of the cartridge should be parallel with the record surface. This is an easy observation to make unless your cartridge has no flat or parallel surfaces. In that case use your cartridge supplier's instructions as a crude guide. Later in this process, we will indicate how you can check final VTA by listening to the cartridge. If necessary adjust the tonearm height (raising or lowering the arm in its mounting post) to achieve basic VTA adjustment. Note that this may also require readjustment of cue height as in many turntables, the cue mechanism does not follow along with arm height adjustment. Another adjustment method is to install cardboard "shims" under either the front or rear of the cartridge between the cartridge and the headshell to "wedge" the cartridge either down or up. Because it is also useful to have the tone arm bearing at about the same plane as the record surface to optimize warp handling behavior, the shim method may be better than overadjustment of arm height. Matchbook covers or business cards are a good source of cardboard shims after trimming to fit. With most Dual turntables, the automatic play position (adjustable at either the headshell or rear of tonearm depending on the model) gives best results.
2. Overhang/offset angle. This adjustment locates the cartridge in the headshell to minimize tracking error. You **MUST HAVE** one of the gauges mentioned last month to make this adjustment and you must make the adjustment in accordance with the instructions furnished with the gauge. The paper gauges furnished with your turntable are not accurate (including, we have rechecked, the paper gauge supplied with the Harman-Kardon T-25 which gives results about .2 inch too short - sorry about that, the T-60 gauge is accurate).

You will be sliding the cartridge forward or backward in the headshell (with an old AR, sliding the arm tube itself) to locate the cartridge tip for minimum error. If your tonearm base is located on the baseplate properly for its length and offset angle, then a good adjustment can be made well within the adjustment range of the slots in the tonearm. If the tonearm is poorly designed, mislocated, or too short, it may not be possible to even come close. It is not unusual to have to turn the cartridge inward (twisted horizontally in the headshell) to make up for too small an offset angle built into the tonearm. With most major "mid-fi" Japanese turntables, you will find your gauge shows that the tonearm is too short. In this case, the best you can do is to mount the cartridge all the way to the front of the arm, to get as close as possible. The problem is these manufacturers seem not to know about Baerwald's (see November, 1984 issue for details) work, and make their arms to have minimum error at the end of the record. Most gauges supplied with Japanese turntables give this result too, with large errors on the rest of the record surface. With Harman-Kardon turntables, and most with separate arms (properly installed) it is possible to get the adjustment right on the button, with much better sounding results. After making this adjustment, tighten the mounting screws firmly, reconfirm the adjustment (it could have "gone away" while you were tightening the screws) and also recheck the VTA adjustment made earlier.

3. Horizontal tracking angle. Set a thin mirror or reflective thin disc on the turntable and lower the arm onto the mirror. Looking at the arm - cartridge from the front (end on) the reflection in the mirror should be a straight continuation of the cartridge itself. If the reflection is angled, the headshell - cartridge is not horizontal with the record. This problem may, or may not be adjustable. In some arms, the headshell has some slop and can be slightly twisted and tightened to straighten things out. With others, you may have to shim under one side of the cartridge to level it. Obviously, what we are trying to do is get the stylus tip perpendicular to the groove (when viewed end on).

At this time check the locations of your headshell wires to make sure they cannot hang low and contact the record surface.

4. Final balance. Now it is necessary to go back and carefully rebalance the tone arm. Use an accurate stylus pressure gauge and set the tracking force near the high end of the cartridge makers recommended range. For advertising reasons, nearly all cartridge makers claim their cartridge will track at "one gram or less." Wrong! This is done

because everybody has been told that super light tracking forces are a "good thing." Sorry, tracking too lightly will cause violent loss of contact between the stylus and the record groove, causing instant breakup and rapid record wear. Our suggestion, if, for example, the data sheet claims your cartridge tracks from between "one to two grams," try about 1.6 grams as a starting place. Too low a tracking pressure always causes poorer performance and greater wear than tracking at the high end of the recommended range.

5. Anti-skate adjustment. We get the most repeatable results using a blank disc. The turntable is turned on, and the arm lowered onto the rotating blank disc. If the anti-skate is set too low, the arm will drift in towards the center of the record. If the anti-skate is set too high, the arm will pull outward. It should be possible to set the adjustment so the arm simply stands still and doesn't move out or in at all. Check the setting at several places along the travel of the arm. Because the exact anti-skate forces needed are not the same across the whole record, and because some adjustment mechanisms do not match the forces required exactly, you may find you have to compromise the setting to get a good average result. If your arm bearing friction is too high, you may not be able to get a stable anti-skate adjustment at all (you need a new tonearm!) and the side forces caused by some end of the record trip link and arm lift devices will also give you misleading results. It is possible, if you have lots of patience and very good eyesight, to eyeball this adjustment without a blank disc. While playing a record, lift the arm with your cue control and watch (from end on) the stylus as it is lifted from the groove. If the anti-skate is properly adjusted, it will lift straight up out of the groove with no sideways motion (assuming a properly adjusted cue). If the anti-skate is not properly adjusted, it will cause a side load on the suspension of the cartridge and the stylus will "snap" sideways slightly as the cue lifts the arm and the side forces are removed. This action is very difficult to see without training but it will give you a very good anti-skate adjust without tools if you can repeatably see the result of an improper adjustment.

It is now time to dig back into your owner's manual again to readjust your cue height, auto lift position, arm rest height and location, and finally a complete recheck of the overhang and offset once more with the gauge you purchased last month according to our instructions (you did buy one didn't you?). Reinstall your turntable on a level, dense (a stack of concrete blocks works just fine) and acoustically isolated locations (out of the line of fire from your speakers, for sure). Clean your RCA phono plugs, make sure your

ground wire is firmly attached, and you should have music again, better than ever.

If you have questions, feel free to call us (in particular, David Umeda, our turntable setup expert, who organized and advised me on these last two issues) at 612 890-3517 regarding them. Sorry, we just do not have time to answer letters regarding specific system setups.

*Frank Van Alstine*