AUDIO BASICS

A MONTHLY NEWSLETTER OF AUDIO INFORMATION
VOLUME NINE NUMBER ELEVEN NOVEMBER, 1990

We Opened a Can of Worms Regarding "Bitstream" CD Players and We are Going To Keep it Open!

It seems our information last month showing that the mathematics of so called one-bit CD players means they are really 8 bit systems has caused quite a bit of flack on the audiophile computer nets. The industry apologists out there are now claiming that the machines are not one bit at all, but actually have four-bit capacity first converter stages.

Gosh, how wonderful, that means the machines don't have 8-bit performance, they really have 12-bit performance. Whoops, that is still losing much of the 16-bit data from your CDs. Perhaps we have improved from kiddy phonograph to plastic rack system capability. Wonderful.

Yes, you can achieve a sort of 16-bit resolution from a 256 times oversampling 1-bit system if you play games in storing data, but you cannot do it over the full audio power bandwidth spectrum. The system behaves much like a slew rate limited amplifier - OK on narrow band test signals but "fingernails on the blackboard" on music.

The apologists claim that the 1-bit systems sound just fine to them. That is a shame. To one who cares about the spirit of the music, they are obviously awful. Definition and dynamic range is destroyed. The sound is like that which makes you detour around the front of the shopping mall CD store.

The apologists also say that this technology is still in its infancy and to give it another year or so. Gee thanks, that does a lot of good to those bamboozled into buying it now. 1 bit data with 256 times oversampling still resolves only 512 levels, both now and next year. If you want to up the oversampling a bit, from 256 to 262,144 times oversampling then you will match today's 16-bit times 4 oversampling systems. But you will need to increase the clock frequency from 11.2 megahertz to 11.2 gigahertz and that will ruin the whole result behind the plan - namely to make the digital circuits cheaper because the users cannot tell the difference anyway.

Which CD Player To Buy?

It is time again to advise you of which Philips made CD player to purchase if your short term plans are simply for a basic and inexpensive machine that could be upgraded later. Essentially, if the unit is not on this list, then it is not a 4 times oversampling machine and you should avoid it. Philips builds many "promotional" machines designed to be sold at very low warehouse barn prices. These machines are built down to a price, and they do not contain the high resolution digital circuits

Published each month by Frank Van Alstine of Audio by Van Alstine, Inc., 2202 River Hills Drive, Burnsville, Minnesota 55337 USA. Telephone 612 890-3517. Subscription price for 12 monthly issues is $16.00 per year plus $8.00 per year for foreign air mail. Annual back issue sets available from 1982 at $15.00 per year.

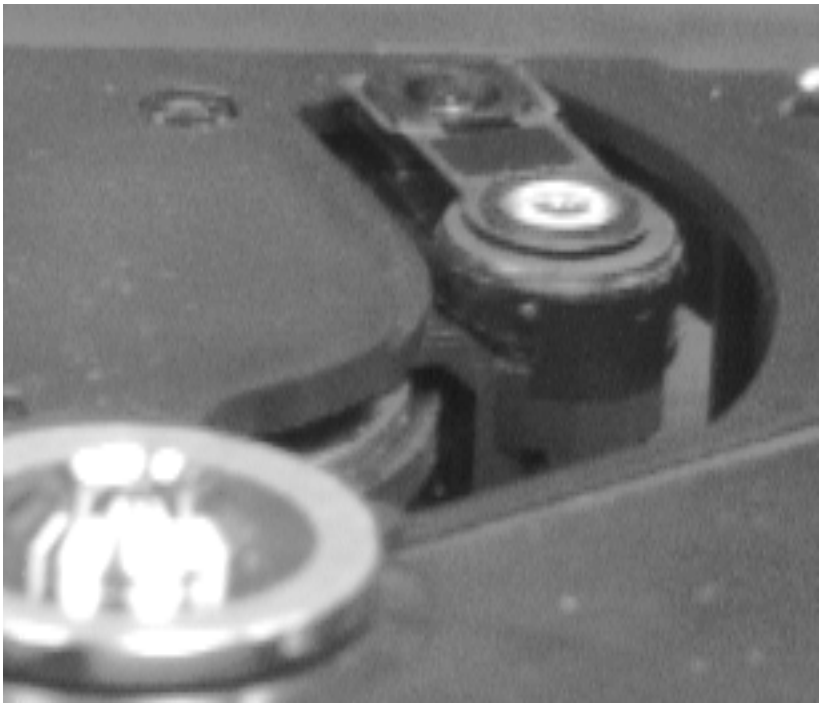
Philips is famous for. In general, *if the machine does not say 4 times oversampling and digital filtering on its faceplate*, it does not contain these circuits and you should avoid it.

At this time, we are using the Magnavox CDB610 CD player chassis. It is a full function four times oversampling and digital filtering machine with remote control and a stiff solid chassis, complete with the newest high reliability CDM4 transport. The Magnavox CDB630 is essentially the same machine but with an additional "feature", a electronic remote volume control. Unfortunately the remote volume control is essentially a low resolution digital switch and it must be removed from the circuit to avoid degrading our audio circuit improvements. Thus you end up paying more in the first place for something you will pay more for later to have us remove. Thus the 630 is not as good a choice as the basic 610 model. There is a 602 model available too, it was the same as the 610 but without remote control of the basic functions. Since the 610 is priced only a few dollars more, it is a better value.

The CDB502 is another current Magnavox model that is suitable for our circuits. It is a bit different in its mechanical package - the entire transport actually is mounted in the sliding, opening drawer instead of just a disc holder tray. Thus you have easy access to cleaning the transport hub and laser lens, but perhaps easier access to getting it dirty too. The internal circuit board layout and the combination of digital logic and filtering operations into a different chip set than the other machines use makes this chassis more challenging for us to get good results. We prefer to use the 610 but we can provide high quality performance with the 502 chassis too.

Last year's model, the Magnavox 582 gave us good results. Machines built late in the production run when there was a switch over from CDM2 to CDM4 transports had a much better yield for us. Since a new CDM4 transport is about $150 installed out of warranty, it is a good idea to make sure you get a 582 with the best CDM4 transport. Too tell the difference you will have to remove the cover (#10 Torx screwdriver needed - available at Sears). Then run the tray out, exposing the transport and then swing up the top hinged disc clamp so you can see the laser focusing lens on the end of the pivoted swing arm assembly.

CDM2 Transport (older)



First, look for a sticker saying CDM2 or CDM4. If you find one or the other you need not look further. Next note that many CDM4 units are built from white composite material, while CDM2s are always black. The CDM2 laser focus lens is mounted in a bright colored thin flat spring like fixture, one spring leaf surrounding the lens, a second below it. The CDM4 may have a black plastic cover over the end of the lens assembly, the CDM2 never does. Many CDM2 units had a tiny patch of black electrical tape on the housing in front of and below the lens. With the CDM4 you can see the copper colored drive coils in this location. With the CDM2 you will only see the dark colored barrel below the lens. It's really tough to give you a clear visual reference here. Perhaps the two video pictures will help.

We can still install our circuits in some older Philips made machines such as the two year old 472 and 473 models and the three year old 460 and 560 models. The 2041 and older were 14-bit machines and should be avoided now. The 650 was the first of the lower cost 16-bit machines, the most trouble prone, and it should be avoided too. However think carefully about the economics of sending us an older machine now. Except for late production 582 models, the other older machines have the less reliable CDM2 transports. By the time we replace a transport in an older machine, your overall cost for an Omega CD player, for example, will get very close to the cost of our complete new 610 based Omega player with a complete new warranty. Unless you have a really current and good working machine, it will generally be more cost effective to simply order new from us than to rebuild your old player. And of course unless you have one of the models recommended herein, we cannot work on it at all.

How about the more expensive Philips brand machines? They are just fine. We can certainly install our circuits in your Philips CD40 and at extra cost in the CD60 (an additional stage of electronics is needed here to upgrade the motor driven remote volume control circuits too – and note that the motor driven precision volume control is the only proper way to get a remote volume function without screwing up the sound). Once we get to machines with a more expensive original price, you are paying too much for "name" and not enough for technology. Remember folks, it not the wrapping of the box that is important, it is

CDM4 Transport (new and better)

what is inside it. We suggest you stick with modestly priced wrapping and pay for great insides instead. It's the circuits that play the music, not extra buttons on the faceplate. But for those of you who insist, we can supply our circuits in the Philips CD40 players instead of Magnavox CDB610 players for $75.00 extra and an extra 3 weeks lead time.

How about those high grade DACs? They make for interesting promotional literature but not better music. Note that the deviation from perfect linearity starts 80 to 90 dB down even with the standard DAC. Note that the noise floor of the CD player is at best 70 dB UNWEIGHTED (we measure all of the noise, we don't filter out the noise first before measuring to get impressive paper specifications). Note that deviations in linearity that begin 10 to 20 dB below the noise floor of the machine simply are not audible. But if you are still neurosed, we can install the Crown DAC in the **CD40 only** for another $50.00. You will never hear the difference but we will take your money just to make you happy. Japanese machines - forget it. Philips invented the technology and has a digital chip set that works flawlessly without adjustments or gimmicks. I have not heard an oriental machine yet that I feel is faithful to the spirit of the music.

O.K. folks, that is where it's at in CD players right now. We get consistent, reliable, and extraordinarily musical results with the Magnavox CDB610 chassis and with the 502 or CD40. Paying more for a more expensive chassis is throwing money away, buying an older chassis or one not on our list is likely buying problems and inadequate performance. Call us if you have more questions.

Oh yes, one more thought, either in or out of warranty repairs to older transports now includes the installation of the new CDM4 transport in the older machine. So if you have bad news and need a transport replaced in an older machine, the good news is that you get the upgraded CDM4 transport installed making your machine actually better than when it was new. We can keep those old machine running for a long, long time.

Finally, nobody packs the old machines correctly when sending them to us. They come in upside down, missing travel screws, with drawers hanging open, with CDs still inside them, and never in the original foam inserts and then double boxed. Sending us a good working machine to rebuild and having its transport hammered to death because of inadequate packing is expensive folly. Sure we make a profit selling you a new transport that you would not have needed if you packed properly. We would rather not have to do this. Please - if you send us a CD player to rebuild, pack it so that it will survive the trip. We would rather have you happy by not charging you as much and getting your machine done promptly and without unnecessary expensive repairs.

Please call us at 612 890-3517 for prices and circuit availability before shipping us your CD player for upgrade.

Keeping the Dyna FM-3 Working

Finally it is time to keep another promise - namely the one we made last year that this year we would discuss the care and feeding of the old Dynaco FM-3 vacuum tube FM tuner.

Why (might the uninitiated of you ask) would anybody possibly be interested in a 30 year old vacuum tube FM radio circuit

design? Well, folks, for one very good reason - its sound. The Dyna FM-3 tuner, properly working and aligned, is dramatically more naturally musical than any tuner that ever came out of Japan at any price, and is only exceeded in pure listening quality by a handful of modern tuners. We can beat it with an Omega, Fet-Valve, or Transcendence tuner. The best vacuum tube Macintosh tuners are better, as is the Marantz 10B. But for music per dollar, especially if you know how to maintain this little Stewart Hegeman designed wonder, the Dyna FM-3 cannot be equalled. Dynaco's unique achievement was to design the FM-3 as a user assembled kit (from bare PC cards up) and to allow an intelligent kit builder to completely align the unit without test instruments for excellent and repeatable performance. Because of the success of these design goals it is still possible for an owner to keep an old FM-3 inexpensively aligned and musical, with a few catches here and there that we shall tell you about. Lets get started.

You must have the original Dynaco construction and alignment manual for the FM-3 to make sense of what we are saying and to perform any work or alignment on your tuner. If your manual is gone order a replacement from Sound Values, Box 551, Dublin, Ohio 43017, phone 614-889-2117 now. There is also a chance that your unit may be the older FM-1 model with the FM3X multiplex module installed later. We do have a beat up, but readable, copy of this older FM-1 manual we can photocopy for you for $15.00. There is also one further iteration - the mono version of the FM-1 with a tiny 10 watt power amplifier built in instead of the multiplex board. We have the manual for that too (another $15.00 photocopy process) but we highly don't recommend its use - it ran so hot it fried itself and all the surrounding tuner circuits and there probably are not any left alive now.

First, although we can make silk purses out of sow's ears, we need a live sow to start with. So let's start by making sure your sow isn't dead. The FM-3 has a few fatal problem spots – parts that may need replacement that simply are not available any more and that the tuner cannot live without. Lets get them out of the way first so you won't try to resuscitate a dead pig.

The most obvious fatal injury is the tuning eye tube. If that is defective it is all over, there aren't any more. If yours does work, be kind to it, carefully remove it and guard it with your life when tinkering with the circuits in your FM-3. The next two weak spots are the discriminator transformer (T2) and the dual slug Mplx transformer (T73). Both of these parts are gone and both must be good for the tuner to work. If the main tuning capacitor (C1) has warped plates from old age and lots of heat, proper dial tracking alignment from one end of the band to the other will not be possible, if its bearings are noisy, you will get static when you tune. Needless to say this part is made of unobtainium too. Finally you cannot depend on long distance service to keep an FM-3 running. There are many tuning adjustments and some are almost certain to shift during shipping, sending the tuner out of alignment. We only work on units that you can carry in to us and carry home. The alignment simply won't survive the vibrations of long distance shipping.

Sound Values does have many of the service parts for the FM-3. For example they have all the tubes (except the tuning eye). They have the germanium diodes used in the Mplx circuit (replace all four if any are bad) silicon diodes won't do here – too high an on resistance. Sound Values has a good

supply of the other tuning transformers. *If your unit is older and has flat topped IF transformers replace all four of them, the originals melt inside with age and the tuning slugs bind and break*. Make sure you get the plastic tuning wand for adjusting these transformers too. Sound Values has a small supply of quad filter capacitors for the FM-3 still available (although you can kludge in a replacement with a stack of four discrete capacitors of the proper value). Anyway, now that you think you know whether or not your FM-3 is salvageable, we will tell you about a few of the problem areas – things to check in cleaning up your unit that makes the difference between music and noise.

The typical FM-3 we see to service is on its last legs. It still plays and tunes, but the output has excess hum, the tuning eye tube won't close tightly even on strong signals and the Mplx section doesn't narrow much on stereo signals. The stereo separation is completely gone and the unit suddenly jumps off station as it warms up or if it is bumped. The sound is muddy and compressed and the highs are almost completely gone. What do we look for and what do we do to restore the unit?

First of all, some of the vacuum tubes are weak links. On older units the 6AT8A tube on the front end board is almost certainly defective. This tube tends to fail much quicker than any of the others and is available from Sound Values. Next, the two 12AX7A tubes probably need replacement. A pair of the Chinese tubes we select for Super Pas preamps are a good choice here ($25/pair + $3 shipping from us). The 6V4 tube should not be replaced with diodes because a solid state rectifier will increase the B+ voltage enough to change the gain on all the IF tubes, thoroughly messing up the alignment and stability and making it impossible to realign without a FM generator. Sound Values does have the 6V4 tube too. The other tubes tend to last and last. Don't replace them unless you are sure they are defective.

The next weak link is the quad filter capacitor. If your unit has any significant amount of hum audible at the output, the quad filter cap is likely on its last legs. At last count, Sound Values had about 15 of these parts left. Order one now if you need a replacement, and you probably do. When these parts run out, don't despair. You can simply buy four 33 µF 450V radial lead SU series electrolytic capacitors from Digi-Key and cobble together a discrete replacement.

Another problem area is mechanical. Many units come in with the tuning shaft rubbing against the chassis or the knob rubbing against the plastic tuning eye window. This is caused by the improper mechanical alignment of the front end PC card and the tuning capacitor in the chassis. To cure, you must loosen (but not remove) all the hardware fastening the front end board to the chassis, loosen the screws holding the tuning capacitor cover to the chassis, loosen the hardware holding the tuning capacitor itself in the chassis, and remove (use a solder sucker) the solder connections between the front end (PC-7) board and the chassis, and between the tuning capacitor lugs and the chassis. Now the entire tuning capacitor - front end card should be free to move somewhat in its mounting hardware. Simply grab the tuning knob and pull it gently towards the outside of the chassis (allowing maximum clearance to the plastic tuning eye window). Then tighten enough hardware to hold the assembly in this position, check that you have made enough clearance to stop the rubbing, and then retighten all loosened connections. Sometimes you can eliminate the rubbing

of tuning knob by simply moving it out on its shaft a bit further from the faceplate.

Intermittent operation of the tuner is almost always caused by the combination of two problems. The first problem is a loose mechanical connection at the C8 dial tracking variable capacitor. This is a strange little part consisting of a white ceramic barrel with a metal outer foil attached to the PC-7 card and with a screw running through the barrel and fastened to a nut soldered to the PC card. The screw head is accessible from the bottom of the chassis and turning it even slightly changes the dial tracking significantly. The electrical integrity of this part depends upon having a reliable electrical contact between the screw and the nut. As the tuner ages, this contact oxidizes and becomes looser. Then as the tuner warms up or is even slightly bumped, this electrical connection changes, causing the tuning to drift violently. The fix is easy, a little Cramolin contact cleaner at the junction of the nut and screw. Go back to the Dyna instruction manual and re-read the installation instruction for this part. Note that the spring loaded nut was slightly compressed in the installation process to provide a good tension contact between the screw and the nut. You may have to unsolder the nut and reinstall the assembly again to get that compression fit back to maintain good contact. If all else fails, you can substitute a small fixed value dipped silver mica capacitor (somewhere between 5 and 10 pF at 300V) to stabilize the dial tracking. You will have to play with the exact value to get the stations to tune close to their proper assigned frequencies.

The second (and likely) problem causing intermittent operation and mistuning is bad solder connections on the PC cards. These connections become resistive with heat and age and on kit built units many were never good in the first place. Our advice is to *resolder every single PC card connection in the entire tuner* and then to use Ronsonol lighter fluid and a toothbrush to dissolve and remove all the excess solder flux. Note that some connections had riveted in eyelets. It is common to find that the solder connection was made between the lead and the eyelet only, but with the connection between the eyelet and the PC card loose and intermittent. Make sure all eyelet connections flow from the lead to the eyelet and on to the PC card foil itself. Bad connections make for bad tuner performance. Use a very high quality solder such as Ersin Multicore SN60 or similar. (Digi-Key has it for $6.50 for a 100 foot roll). For proper circuit operation, the tuner must have very low impedance connections between the ground foil on the IF and front end boards and the chassis. This contact must be improved by soldering the PC card ground foil to the chassis bottom at multiple locations around each card. Make sure you solder to the common groundplane only, not to any of the component linking traces. While you are at it, make sure you have very good solder connections from the quad filter capacitor ground lugs to chassis ground and from the tuning capacitor mounting lugs to chassis ground too.

Now lets look at some problem child parts that cause degraded performance. The worst culprits are the two large capacitors located at the Mplx card end of the IF board. These parts, C29 (.47µF) and C31(.22µF) become resistive with age and have poor high frequency response. This causes poor stereo performance because the 38 KHz pilot signal to the multiplex section is attenuated. Replace both of these capacitors with modern film types such as Panasonic EF series film .22 µF/250V and .47 µF/250V capacitors from Digi-Key. While you are at it, replace the two output coupling capacitors

on the Mplx (PC-12) board too. Both C82 and C83 (0.1 µF/400V) should be replaced with much larger value capacitors to avoid rolling off low frequencies. We would suggest a Panasonic EF series 1 µF/400V capacitor in each of these two locations. If any of the four multiplex switching diodes are defective the Mplx section will not work. These (D71 thru D74 IN541) are special low forward resistance Germanium diodes. Normal silicon diodes will not work in this application. If any are bad, replace all four. Finally, make sure all the small ceramic capacitors on the front end board (PC-7) are positioned straight up on the board. Bending many of these over will affect the alignment.

Once you have the unit put together solidly, make sure it is clean. Use a soft paintbrush and toothbrush to get all the dirt and crud off of the circuit boards on both sides. A dirty tuner runs hot and drifts out of alignment. Now you will need to align your tuner exactly following the procedure in the Dyna manual. The tuner can be aligned without test equipment with the following little caveats that Dyna did not tell you about.

First, there actually was some unadvertised pre-alignment done at the factory. The IF transformers were each pre-aligned to 10.7 megahertz because there was no way for the end user to tune them in to this frequency without test equipment. In the Dyna manual the user is cautioned to not make much change in the alignment of the first IF transformer, but is not told why. The Dyna alignment procedure allows for the alignment of each of the following IF transformers to the first one, but does not guarantee the certain alignment of them all to 10.7 meg. Thus, if the adjustment of the first transformer is changed very much, then further alignment downstream only misaligns all the others to whatever frequency the first is now randomly sitting at. A misaligned IF section will have poor dial tracking, poor sensitivity, poor frequency and phase response, and will be sensitive to external out of band signals (interference). If you suspect your IF section has been adjusted all to hell, then you must take your tuner to a shop that can do a quality FM alignment so they can set the IF transformers back to a 10.7 Meg frequency. You simply cannot do this yourself without expensive equipment.

Second, the alignment procedure includes installing a "gimmick" – a small value capacitor made of a short piece of wire, on the IF board after part of the alignment is complete. Inevitably, the hobbyist forgets to remove this little part before starting the alignment process over again later. It has to be saved for later re-installation. Remember, read all the directions before you start unless you like to do things over again.

That is about all we can tell you. If you have a FM-3 put together solidly out of working parts, and you follow the factory alignment instructions properly you should be rewarded with an open, smooth, and musical FM performance well worth the time and effort expended to get your tuner working at its best. Of course you are going to need a good antenna – another *Audio Basics* topic for the future. Keep subscribing, you can never tell what we will come up with next to help you.

Used Equipment List

We have a lovely Super Tuner Two available for you. It is a unit we built 5 years ago in a new Dyna FM tuner shell with a silver faceplate and black cover. It has resided in a mansion in Beverly Hills ever since and still looks and works like new and is the nicest used tuner we have seen here in a long time. $295 will get you outstandingly musical analog FM performance and a 3 month parts and labor warranty too.

There is one stock Dyna Pas-2 preamp still available, checked out, controls cleaned, supplied with good tubes, and with a 90 day warranty for just $99.00. Its complete and clean and will make a great starting point for a beginning high fidelity system and is just the place to install one of our Super Pas Three rebuild kits. Buy this with the rebuild kit at the same time and we will knock off $25.00 – get the preamp and the rebuild kit for $274.00 total. What a deal!

It is Renewal Time!

Once again it is that time of the year to look at the number to the right of your name on the address label from your *Audio Basics* envelope. If that number says 9012 or 9101 then your subscription is expiring now. We will hold our renewal price the same for now, even though we know postage will cost more soon. A renewal is $16.00 per year in the U.S.A., $20.00 for Canada, and $24.00 for the rest of the world. Please get that check to us now so we can continue your subscription without interruption. **There is still time for gift subscriptions.** Remember that Darlene will include a Christmas card to the person of your choice (at no extra charge) telling them they are getting a gift *Audio Basics* subscription from you. But get your order to us promptly so we can get the cards out for Christmas. Thanks for your support.

Frank and Darlene Van Alstine