AUDIO BASICS

A MONTHLY NEWSLETTER OF AUDIO INFORMATION

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Why Are We Doing This? Why Write *Audio Basics*?

We write *Audio Basics* because there seems to be no rational middle ground between the technophiles who refuse to listen and the audiophiles who refuse to measure.

We write *Audio Basics* because nobody else seems to understand that "I like it" is not a valid answer. The guy on the back of the bus with the boom-box turned up to full distort says "I like it" and in the absence of meaningful data, his "I like it" is just as valid as anybody else's.

We write *Audio Basics* because we are long tired of observing the six blind men describe the elephant.

We write *Audio Basics* because we are tired of seeing resources wasted sending cats to obedience school. One can write glowing brochures describing the high quality of the beds, food, trainers, and facilities at the obedience school. Unfortunately, this doesn't justify a high price for the school - everyone understands that a cat simply isn't going to learn a thing. Also unfortunately, everyone does not understand that subjectively assigning analog problems to digital circuits is like sending your cat to obedience school, with the same cost and rate of success.

We write *Audio Basics* because nobody seems to understand that once you know that the measurements are bad there is no point in listening to it. Yes, you might like it a lot (see paragraph two above) but first you need to know that once you know that the output is not music, then whether you like it or not is immaterial. You are just as entitled to have bad taste as anyone else.

We write *Audio Basics* because nobody seems to know that the very best an audio engineer can do is to not screw up the source material. The audio amplifier and loudspeaker is not a musical instrument, it is not part of the performance. It is simply a copy machine. Its goal is to present you with a copy of the original musical source material so perfect that it can "pass" without being detected.

We write *Audio Basics* because nobody seems to be getting their priorities right. Take a throwaway loudspeaker and unwind the woofer or tweeter voice coil. You will find you have many feet (20 to 50) of hair sized 30 gauge copper magnet wire. This wire is in series with your speaker wires. In a series circuit, the maximum current flow is determined by the most resistive element. Worrying about the brand, size, composition, and gauge of the last ten feet of speaker wire is ludicrous. This isn't where the problems are.

We write *Audio Basics* because modern audiophile priorities seem destined to have you spend as much money on magic and witchcraft as possible. Whip down to the library and find the book "Everything magic has done to improve the human condition over the centuries." It is full of blank pages. Every dollar wasted on sorcery is one dollar less available for education, engineering, and understanding.

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We write *Audio Basics* because both the technical and subjective audio camps are full of misinformation and double-talk. The technophiles claim that you need not measure nor be concerned with any aspect of audio performance outside the 20 to 20KHz band because a human cannot hear outside that band. The audiophile says don't measure at all because the measurements normally made don't predict the subjective musical quality of the unit. Both seem more interesting in proving each other wrong than in looking for the truth.

We write *Audio Basics* because for the past ten years there seem to be no other rational voice willing to stand up and say, "the emperor has no clothes on."

We write *Audio Basics* because nobody seems to notice the difference between knowledge and beliefs any more (and if they do notice, they don't care). "What is your opinion" seems to be more important than "what do you know."

Lets go into a bit more detail on some of these observations.

We will start by proving that "don't bother measuring outside the audio band" is an invalid technical premise.

Recently, Julian Hirsch reiterated this tired old premise in *Stereo Review* while discussing amplifier slew factors in relation to the demands placed on power amplifiers by CD players.

The slew factor of a power amplifier is a number that expresses the ratio of the maximum full power frequency an amplifier can play without gross distortion to the highest frequency a human being can perceive - commonly considered to be 20,000 Hz. For example, some Adcom amplifiers have been measured to have a slew factor of 3. This means crudely that at 60,000 Hz (3 times 20,000 Hz) a sine wave in will be measured to have significantly increasing distortion at the output. Since a slew factor of 3 indicates that the amplifier has at least three times the bandwidth necessary to cover audio frequencies without significant harmonic distortion, then the technician claims we can be assured that this is more than adequate to guarantee all the bandwidth we need buy to have undistorted music. (In comparison, the slew factor of any recent Audio by Van Alstine power amplifier is infinite. The test process consists of driving the amplifier to full power at 20,000 Hz and then increasing the frequency of the input signal until the output shows evidence of significant distortion. When this test is attempted with an Audio by Van Alstine amplifier, the output never shows increasing distortion. At ultra-sonic frequencies the output is simply attenuated - the signal gets smaller and smaller until it vanishes - but without significant increasing distortion. In effect, we put on the brakes instead of letting it crash.)

Julian Hirsch recently observed that the advent of Compact Disc players has made the power amplifier's task easier than ever. Because of the basic specification of the format (a 16-bit word sampled 44,000 times per second) it is critical to filter out all frequencies above 22,000 Hz before the CD is produced. This is because of the nature of the process. Any frequency sent to the A to D converter above 22,000 Hz will be "aliased" to a new frequency - an audio band frequency equaling the original frequency minus 22,000 Hz. So, for example, a spurious noise in a microphone line at 30,000 Hz (normally not directly audible) will be aliased by the A to D converter to 30,000 Hz minus 22,000 Hz = 8,000 Hz, a very audible (and annoying) noise indeed. Therefore anti-aliasing filters are a critical part of the process in producing the CD. They must be ahead of the first digital recorder if the original performance was digitally recorded. They must be ahead of the first studio/sound lab digital processor and or mixer if the original performance was recorded to an analog tape and later translated to digital for production of a Compact Disc.

Julian's point was that with a Compact Disc, *the absolute maximum frequency that can be stored and played back by the medium is 22,000 Hz*, and thus the demands on the power amplifier are absolutely defined by this upper limit and so measurements of a power amplifier

beyond this upper limit is irrelevant. He is in effect suggesting that our engineering, which has resulted in power amplifiers that never exhibit rising high frequency distortion and which have extended pure high frequency bandwidths, is unnecessary overkill. He implies that our efforts can have no effect on perceived musical quality and that in fact it is a waste of time to even measure our improvements – if it is over 22,000 Hz you cannot hear it, it cannot be recorded on the CD, and who cares what you do better than that at all!

Julian is wrong!

What happens when you inject 44,000 Hz into your loudspeakers at high input levels!

You burn out your tweeters, that is what happens!

Can you hear 44,000 Hz?

No.

Can you hear the effect that excess 44,000 Hz had on your audio system?

Yes you can! Your speaker systems no longer have any tweeters and thus cannot play any audio frequency highs at all. Even Julian might hear the difference.

We have just proved that out of band signals can have an audible effect on what you hear from your high fidelity system.

By the way, what happens if you put DC into your speakers at sufficient levels? The woofer goes to its stops, and if the DC level is adequate, the suspension or voice coil is mechanically damaged or the woofer voice coil burns out (we have even seen speakers that have caught on fire and one with the magnets melted clean off!). Out of band signals can have an audible effect on the high fidelity capability of your audio system, even if you cannot hear the out of band signal directly.

But where could that 44,000 Hz come from? Julian said (and we agree) that the highest frequency that can be stored and played back by the CD medium is 22,000.

The highest frequency that the CD can store is not the highest frequency that can come out of the CD player. This is the point at which the technophiles completely drop the ball.

The sampling frequency of the CD is 44,000 Hz. In the process of retrieving and generating the analog musical output of the CD player, two frequencies of interest are produced. The first is the desired 20 to 20 KHz audio frequencies, *the second is an undesired 44,000 sampling frequency.*

The output amplitude of the 44,000 Hz sampling frequency and the presence of any higher frequency harmonics of that sampling frequency are completely dependent upon the presence and design, execution and quality of the output filters of the particular CD player under consideration. Note that in a times 2 oversampling CD player, the undesired switching frequency is increased to 88,000 Hz, in a times 4 oversampling CD player to 176,000 Hz, and so on. The frequency of potential excess garbage is increased, not eliminated or made less damaging. In a one-bit system, potential spurious noise artifacts are spread across the band by the noise shaping circuits (an advantage) but the 8-bit musical resolution potential removes one-bit as currently executed from serious consideration as a high fidelity source in any event as we have already discussed.

Anyway, back to the undesirable sampling frequency output from the CD player.

The current standard for measuring distortion in a CD player is to make the tests after inserting a 22,000 Hz low pass filter at the output of the CD player! First filter out all possible evidence of any problems before measuring for possible problems! How clever! This is like taking a sample of water from the River Gangues, filtering it, and boiling it, and then sending it to the testing lab, which will then report it is safe to drink. Have a glass!

Yes, CD players are supposed to have low pass output filters built in. How well do they work? What do they screw up in and of themselves? If the standard is designed to hide and not to measure for any possible problems then you will never know. This is a truly useful testing procedure only if you are a large manufacturer of very bad CD players trying to hide cruddy design from the masses.

Technicians, would it not be more useful to measure all of the output from each CD player tested at all frequencies?

Would it not be clever to note what spectrum of high frequency garbage is coming out *along with the music* and to contemplate what damage that garbage can be doing downstream.

What happens if you feed 88,000 Hz into an amplifier that is driven to high distortion at any frequency above 60,000 Hz?

Is it happy? Does it still play audio well while slew rate limiting on frequencies above its maximum rate of change?

What happens to your tweeters when spurious ultra-sonic frequencies are fed into them? Frequencies originating from spurious output from your CD player, from cartridge mis-tracking, from spurious output from the 38 KHz multiplex switching frequency of your FM tuner, or even from RF injecting into your cables and AC power can drive your power amplifier bananas, causing it to produce even more distortion out than what came in.

Even before your tweeters fail completely they will distort on the out of band garbage.

How much garbage does your system produce? How badly are your tweeters distorting - all the time?

Is it possible that a high fidelity system might actually sound closer to live if all the sources of gross distortion were taken into consideration, measured, and eliminated in the design process?

Why doesn't anybody ask these questions except *Audio Basics*?

Why doesn't any technical publication source volunteer to increase the scope of their measurement procedure to try and find where the engineering problems really occur? Why do they claim that the problems don't exist when they have made no effort to investigate? They just say everything sounds the same.

Why doesn't any subjective publication source seem interested in making any measurements at all? Do they really think that simply comparative listening to various effects can determine what the cause was? Do they think the high price tag only and the thickness of the faceplate, without documentation of what is screwing up and what is not, can they determine good or bad? Is their (or your) "I like it" better than that of the guy with the boombox?

Why do so few people seem to care?

We do care. We do have the intellectual curiosity to want to find out why. We do have the knowledge to understand that subjective impressions based on no data are not consistent and are likely not valid. We are willing to raise "unpopular" questions even though we know that the king tends to execute the bearer of bad tidings. (The bearer of the news to the Spanish king that the English, led by Drake, had destroyed the Spanish armada came up with a useful statement – he told the king, "I have wonderful news for you, we have just learned that Spanish sailors are much better swimmers than English sailers are," and then vanished before the king could do any further analysis of the news.) In our case, when we proved mathematically and subjectively that each phono cartridge brand required a different optimum resistive loading and that the industry standard of 47KΩ was not really a useful standard at all, the end users tended to simply go buy a different brand of preamp - because other manufacturers did not tell them the bad news. In spite of that we will continue to bring you the bad news when it is true, and do the engineering research and provide the information to make things better.

That is why we write *Audio Basics*.

The Walk-Ins Strike Again!

Occasionally one of our clients brings or sends in an alien piece of equipment for us to evaluate in our lab - design studio - listening room. We welcome the opportunity (but don't you send us anything without prior telephone discussion with us).

This month two sets of home built loudspeakers and an Adcom 865 (665?) CD player were evaluated here.

The speakers gave Dave Umeda an interesting double-take. It seems as though a client from

the East Coast has been working to develop a commercially viable loudspeaker. He made a very attractive slender floor standing column designed with one of the new ideas – a midrange woofer above a tweeter above an identical midrange woofer. Swan uses this configuration, as do several other suppliers, claiming it offers better imaging by creating a point source for the sound at the center of the tweeter (or whatever).

Our client first sent us photos of the speaker (very attractive and built with obvious good workmanship) so Dave Umeda and I told him to send them on out for our listening evaluation.

About a week later (before the expected speakers had arrived and totally independently), a local client – another technically skilled hobbyist – called me and dropped by with a pair of speakers he had built. Déja vu! They looked just like the photos our East Coast client had sent and were done based upon many of the same design considerations. Dave was gone for the weekend and evening and quitting time was approaching but we powered them up anyway.

Now when I listen to "new" loudspeakers here my methodology is to connect the speakers to the best electronics in house and listen first to the new speakers. Then, to test myself (and the new speakers) I connect up the lowest priced B&Ws in house that I think will be likely to beat the newcomers. This is a good test of both my auditory memory, the new speakers, and the B&Ws. In this case, there really was not much of a challenge. I hooked up the very lowest priced B&Ws (the $225 per pair V201s) and the little B&Ws were obviously better.

The home-builts were smoother and had better spacial characteristics than these lowest priced B&Ws, but had many more obvious vowel tone colorations in the midrange, did not have as good a high frequency extension or definition, and had bass response that went nowhere at all. Inasmuch as the inexpensive little B&Ws were a quarter the size and weight and cost, they won, hands down.

In discussing the home brew with the builder, I suggested that perhaps the column tuning had gone all wrong – that although the cabinet volume was adequate for good bass response, I suspected that an unintended resonance caused by the cabinet's dimensions was doing a big job of bass cancellation. I also suggested that a big problem to the self builder was that there simply were no really good tweeters available. I knew this designer was thoroughly skilled in the math of crossover design, but I am pretty certain that the parts just are not there to adequately implement the design (at least I have never heard it done well). Since Dave had not heard the speakers, we left them set up over the weekend.

When I came into the shop on Monday morning, Dave had already turned them on, turned them right back off again, and was concerned that he couldn't find the packing cartons to send them back to the East Coast. That is how close these matched the not yet arrived ones. A few days later the local designer called me back to tell me that blocking off half the length of the column actually improved the bass performance! I had been right – too much cabinet volume in the wrong place was doing bad things.

Anyway, about the time the dust cleared, here came the East Coast columns. Déja vu again! The sound was almost identical to the local ones – inadequate bass for the size and cost and obvious colorations in the middle. The imaging was impressive directly on axis (as it was with the other tower) but off axis the perspective faded quickly (as it did with the other tower). Overall, I still felt the B&W V201 was better, because the B&W was more faithful to the overall harmonic structure of the music with lower coloration. Also $225 a pair retail is a better value than $1500 a pair suggested dealer cost. It does not matter what it costs to make, it is how well it works that determines real value. My impression that the world is lacking really good components for home builders to use remains unchallenged.

I have been at this for thirty years now and I have yet to hear a really good home made speaker. I should take that back – long ago (in

the late 1950s) Paul Jensen and I built one that did work – a two cubic foot two-way we called the Sonic Eight. We built it out of unfinished 3/4 inch plywood with an 8" woofer and a 3" paper cone tweeter. It had a tuned port, it was stuffed full of angel hair, and it had a cane grill-cloth. It was rugged, it outplayed all the locally made house brand speakers (it gave KLH 6s a run for their money) and we sold them for $55.00 a pair! I still have long term clients that would like me to make more of them – but Paul is long gone now and he was the only one of us who knew how to run the table saw without hurting himself. Those days are over – I digress – back to the present.

Meanwhile back to the Adcom CD Player.

This was brought in by an Audio King salesmen who was picking up a new Ωmega 150 power amplifier we had installed in an old Dyna St-120 chassis for him. We have many really good hi-fi salesmen locally. They sell what they have to, to earn a living, but they come to us for their own personal equipment. Our equipment tends to beat the very best they can buy even at salesmen's one-half of list price manufacturer's special deals for them.

Anyway the salesman brought in the Adcom CD player because in the store it had been judged by them to be a lot nicer sounding than their Denon machines.

On the test bench it was difficult to evaluate the Adcom non-destructively. The transport was oriental, the digital electronics chips were Philips, and the audio output chips behaved suspiciously like NE5532s although they were marked with an Adcom house brand. The 5532 simply does not work in a CD output filter - it is too slow and it is not unity gain stable. We would have had to tear the chips out and bench tests them in my IC torture rack to make a better judgement and since the machine was not ours and time was short we went on to listening.

In making a subjective evaluation, I give CD players a real torture test. I play CDs with difficult to reproduce material. The cut "Dusk" from the Sheffield Lab CD "Growing Up in Hollywood Town" is a real test session all by itself. I tossed that cut onto a $295 Δelta CD player then burning in, feeding the client's Ωmega 150 power amp to a set of B&W Matrix 801 Series III loudspeakers (not to worry Series One and Special Edition owners you are not obsolete, the Series III sounds just like the earlier models, assuming you have made our crossover fix). The Δelta CD player plays the music of the female voice, the definition and detail of the high frequency transients, and the power of the bass with no mud or boom.

We then plugged in the Adcom. Its tolerance factor was approximately 30 seconds in our system. The highs were rough, the bass boomed, and the vocals sounded canned. The salesman noted that he knew we made good CD players, but he had not realized they were THIS good. I reminded them this was our cheapy - our lowest price unit and that everything else we did was better yet. Another client was listening too. His comment was what was wrong with the Adcom? He thought that all CD players were supposed to sound the same. Well, at least the salesman reminded us that the Adcom was better than a Denon. Isn't he lucky?

Used Equipment

Ωmega Pat-4 Preamp (new circuits May, 1991) with custom made gold jacks, ceramic switch, AVA buffered tape output circuits, dual tape monitors, and a very clean original Dyna faceplate and cover. $295 with a one year parts and labor warranty. This is a great sounding preamp.

Ωmega 100 Preamp. Our custom circuit modules in a like-new Hafler DH-100 chassis. Pretty looking, simple to use, and musically pure. $225 and a 90 day warranty.

New Ωmega 600 Power Amplifier. This 350 watt per channel (550 watts per channel in 4 ohms) beautiful monster is just what you need to drive big Acoustats, Apogees, older big Infinities, paralleled big Magnaplanars, and other low impedance inefficient loads. It has 16 paralleled big die mos-fets and ±90V power supply and is all new in new Hafler 600 metal. $2295 and our 2 year parts and labor warranty. It is the best we make and is rarely available. We have one now.

Frank and Darlene Van Alstine