AUDIO BASICS

A MONTHLY NEWSLETTER OF AUDIO INFORMATION

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Audio Engineering vs. Audio Magic, an Overview

It is time to sum up and repeat some of the audio basics we have been teaching you for the past several years. We need to be sure that our newer readers really do understand the concepts that our teachings are based on – concepts that we may have assumed they already know but that they have not been exposed to because they have not read the *Audio Basics* issue that covered that topic in detail in the past. It is also time to express this knowledge once again to reaffirm our consistency to our long term readers. When we discuss a new concept or when we share new knowledge, you need to have a firm understanding that the basics of good audio engineering practices are not being violated. It is time to set forth those basics again.

The Goal: Don't Screw Up the Source

If we are going to attempt to design "better" audio equipment, we must first define what the goal is. What is the ideal? What do we want the equipment to do?

Obviously, making "better sounding" equipment cannot be the goal. That goal assumes that it is proper for the equipment to have "sound" in and of itself –a ludicrous assumption. We are interested only in the sound of the source music with nothing added or subtracted. The equipment designed to present that source music to you must have no sound in and of itself at all. Anything the equipment adds or subtracts, any change the equipment makes to the sound, is distortion. You may like the results. You might actually like distortion. You have the right to like distortion. Just don't kid yourself into thinking the distortion you like is a better presentation of the source music.

The claim that a speaker is made of "good sounding wood" means that speaker is making resonances all by itself, resonances that were not part of the original source recording. The good sounding wood is simply distortion. The speaker that claims to generate 90% reflected sound is generating reflections that did not exist in the source recording (take the orchestra outside and record it there as a final proof) and you cannot turn those extra reflections off. The "ambiance" generated by "good sounding audiophile grade capacitors" are simply microphonic reverberations and inductive reflections from these soft film parts. Tap on one in a phono circuit and listen to the ringing from your speakers – you will hear the same sound you get from a defective vacuum tube. The "ambiance" was not in the source music, it is simply all the additional "reverb machines" you have added – reverb machines that were not part of the music.

The only design goal that is rational is equipment that does not screw up the source

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music at all, equipment that adds or subtracts nothing from the music, equipment that does its necessary job of retrieving the music from the storage medium and converting it into an energy form that your ears can receive without changing the information content at all. The composer, conductor, musicians, and musical instrument makers are the artists. They create the music, they make the original information. Those who record and capture the music and provide the necessary equipment to allow you to play the music back are not artists. They are engineers and technicians with the duty to not screw up the music the artists made. They are not creating the information and the communications. They are merely those who store and transport that information to you.

As we come closer to our goal you will appreciate the music more and more because the music really is the musicians and their wonderful ability to communicate the emotions and meanings of the language of music to the rest of us. The more clearly we can hear that communication, the better we understand it and the more meaning it has for us. We believe that if we bring you devices that allow you to better understand the messages, you will understand that we have provided you good value.

"I Like It" Cannot Be the Only Evaluation Criteria.

We are forever plagued with queries from "knowledgeable" audiophiles with complex and expensive bizarre systems that obviously are creating sounds not related to the music. They are searching for "better" equipment - defining better as stuff that provides even warmer and more golden mid-range resonances and sweeter and more vague sounding highs, and even louder low frequency noises. When we politely suggest that they might be better served by searching for equipment that has been designed to not screw up the source material rather than to find even more expensive equipment that messes up the music in some superficially pleasant way, these arrogant "experts" always coldly reply that since their system has all the "right" brands of ultra expensive components and cables and that since they "like it the best" that it is obviously the best and therefore what do we know. We like to reply that what we know is that the guy on the back of the bus with the $40.00 boom box turned up to full distort "likes it the best" too, and that compared to them, he is way ahead of the game because he only had to spend $40.00 to get a "like it the best" system. With wounded pride, they hang up.

We want to design and produce equipment that we, and you, will "like the best." But we want it to sound better because it more purely passes the source information, not because it makes happy noises that you like today. Thus, before we ever listen to any of our design ideas, they first are thoroughly evaluated mathematically in our proprietary circuit analysis computer program that picks out flaws that even the experts could never hear. We don't even bother to build or listen to circuits that show hints of non-linearities in the computer models, even if those non-linearities are ones that we know make pleasant ambiances. Then, the evaluation circuits go through thorough bench testing because on the bench we can insert complex signals and attach difficult loads that are as of yet difficult to model in the computer. Again, the circuits under test must prove to be only passing the signal and never making the signal before we will ever listen to them. Thus we do not listen at all to equipment (our experiments or other's stuff) that the test bench tells us is making its own sound. We too

could be fooled by the "I like it better" syndrome if we did not carefully cull out all the expensive happy sounds before starting the final listening evaluations. Then finally, only if the equipment actually passes our subjective evaluation process (more on that process later) will we offer it for sale to you because then we can be reasonably sure the new product is one we like because it really is a more transparent mirror on the real world, not just another expensive "I like it."

Good Design Involves Ratios, Not Absolutes

In every aspect of audio advertising, absolutes are thrown at you right and left, with the implication always made that the bigger the numbers, the better. You hear about more amps of current, more watts, faster slew rates, more inches of woofer, more farads of power supply, and so on. What you never hear is how those numbers actually relate to the task of providing you sound playback equipment that is more faithful to the source material.

In effect, you are told what materials and supplies are on hand, but you are not told what the task is you are supposed to accomplish with those supplies. If you are shown only one end of a teeter-totter, will having ten bags of sand (50 pounds each) on hand guarantee that you will better be able to balance it than if you only had one bag? If there is a little caterpillar parked on the other end, then the single 50 pound bag is overkill and the extra bags are an unnecessary excess (especially if you had to pay a small fortune for the extra bags). On the other hand, if it is a caterpillar tractor parked on the other end, that all the sand you can pile on your end will have no effect at all, you will simply break the teeter-totter before it will balance. Thus the claim that our whatever is better because we have bigger, faster, more of, and higher somethings is not necessarily true. One must always consider the claim by asking first what is on the other end of the teeter-totter.

If it is obvious that the teeter-totter is broken then more bags of sand are not going to do any good. For example, consider the design concept that "for good bass the amplifier has to go to DC (Direct Current)." Lots of designers try and do this and most audiophile tweaks think this is a true statement and we are lambasted in the underground press because we don't let our amplifiers go to DC. But, if you let your amp see DC at its input circuits, then you are trying to sell a broken teeter-totter. First of all, the amplifier's power supply can be modeled as a large capacitor in series with the output circuits. A capacitor, no matter how large, does not pass DC. It is an open circuit at DC. Thus, as the frequency response of the amplifier approaches DC, the amplifier runs out of power supply. And as long as the input is DC coupled, it is impossible to make the power supply big enough - you can't make a power supply capacitor that supplies continuous direct current. When it runs out of power supply the distortion goes to 100%. Second, all active devices (tubes, transistors, fets, op-amps, etc.) quit working linearly as excess current is pulled thru them at very low frequencies. Thermal distortion skyrockets, and the end result is clouds of smoke, fried voice coils, and blown output circuits. Again, device limitation means that as the frequency into the amplifier approaches DC, the distortion goes to 100%. Finally, an amplifier with gain at DC and an input that accepts DC cannot be electrically designed as a critically damped circuit as it runs out of power supply and device linearity. At some low frequency it will behave as an undamped resonator. The output will be a mass of internally generated oscillations

having nothing in common with any musical information fed into the amplifier.

Thus those who say that for good bass you must go to DC are actually claiming that they really like 100% distortion at low frequencies and are happy paying lots of money for it. These same folks also tend to "modify" their amplifiers by first bypassing the input capacitors (thus making it impossible to make the power supply big enough) and then by buying expensive bigger power supply capacitors. Then they are happy with the rude low frequency noises the amplifier now generates as its distortion goes up and its power supply gives up the ghost. It sounds different now, and different must be better – sure.

Fix the Correct End of The Teeter-Totter

We suggest that it might be a better idea to look at the other end of the teeter-totter first and keep in mind that the goal was to balance it. We suggest that it might be easier to back the caterpillar tractor off of the end of the teeter-totter rather than attempt the impossible job of adding enough weight on the other end (it will collapse first).

We suggest that it might be a better idea to first design the amplifier (or preamp, etc.) so that extraneous out of band garbage (cartridge mistracking harmonics, CD player switching frequency artifacts, AC power line variations and radio stations riding thereon, etc.) cannot get in to disturb the audio performance. Next we design a wide band and linear audio circuit (of much wider band than any musical instrument and its overtones) and of much wider band than the input parameters so that everything the circuit accepts can be replicated as perfectly as possible. Finally we build a wider band power supply yet (of much wider bandwidth than the bandwidth of our audio circuit design) so that the amplifier can never run out of power supply at any frequency it is ever called on to reproduce.

Which do you think might more satisfyingly present musical bass performance – 1) an amplifier that is guaranteed to generate 100% low frequency distortion or 2) an amplifier that can never be driven to high distortion at low frequencies, that never runs out of power supply, and that can never make its own low frequency resonances? We will provide you choice 2. Almost everybody else sells choice 1. Its funny what the "experts" seem to like these days. Which do you think might cost you less to do right, 1) a DC coupled amplifier with a huge 150 pound power supply that is still inadequate because the power supply can never be a true DC supply or 2) an amplifier designed for perfect audio frequency response with a power supply of wider bandwidth than the audio circuit? Hint: we build choice 2.

Every properly designed device built by man has a finite performance envelope – a range in which it works well. If you push that device outside its performance envelope, it no longer works well. A Porsche 928 has great brakes and will stop really quickly time after time – but not if you drive it into a brick wall. What if the designers spent their design efforts reinforcing the front of the car so that it would not be hurt when driven into a brick wall at top speed? It wouldn't do much good would it, because even if the car survived, the driver would be jelly (its tough to reinforce human beings that much).

Would the design time be better spent towards an intelligent radar braking system that would gently stop the car before it hit the brick wall, even if the driver was too drunk to notice that a problem was fast

approaching? We wouldn't even need to make him fasten his seat belts then, would we?

We suggest that a design goal of providing a large performance envelope and then keeping the device always within the envelope so that it never distorts is a better idea than trying to make an impossible infinite design envelope and finally letting the device generate calamitous distortion. We want music, not sounds for bats and an AC line voltage indicator.

We suggest that a better idea is to intelligently and economically get the ratios right, not mindlessly blow money attempting impossible absolutes.

"Good Sounding Parts" Do Not Exist

We do not build good sounding audio components from "good sounding parts" because *there is no such thing as good sounding parts* – that concept is a figment of the imagination of the purveyors of last century's gold plated bricks who have discovered there are lots more insecure audiophiles willing to buy good sounding parts than there ever were those available to buy the deed to the Brooklyn Bridge. Note also that it is very much easier to print impressive copies of deeds to the Brooklyn Bridge than it is to build the bridge itself.

Actually we have made a scientific test to prove our observation. We have spent days and days holding capacitors, resistors, transistors, and even diodes up close to our ears and listening to them as carefully as possible. We have yet to hear any differences at all between any of them, except one tiny fruit-fly sized surface mount transistor chip seemed to be calling "help me" in a faint little voice.

Would you build a race car out of "fast" nuts and bolts?

Would you choose the aluminum alloy for the wings of an airplane by throwing ingots of it across the room to see which alloy "flies" best?

Can you create a great painting by only selecting a "wonderful looking" set of oil paint tubes?

Is a winning America's Cup yacht built from wood, plastic, metal, and fabric that is selected because it floats good and fast?

Is a high fidelity audio amplifier built from good sounding wires and components?

Don't be silly, in each case the question is absurd. It is simply more difficult for you to recognize the lunacy of the assignment of subjective value to high fidelity parts than in other fields of endeavors because it is more difficult to assign an absolute standard of performance in the field of high fidelity.

There are no subjective sonic virtues or vices that can be assigned to any electronic part. There are however, lots of objective characteristics that must be considered relating first to fitness to the intended application and secondly to durability and reliability.

By fitness to the intended application we mean that the part must be selected for the mechanical and electrical characteristics that work properly within the envelope that it sees in the circuit application. A Goodyear Gatorback 255 HR16 radial tire might be just wonderful on your Corvette, but it is not so wonderful as the nose wheel of a Boeing 747. Gee, it was a really high speed tire, how come it blew out and the airliner crashed while taxiing? A 4700 µF/16V capacitor might be a really well made

part, but not if put in a circuit in which 100 volts could be put across it. 100 volts across a 16 volt rated part is instant failure. Well then why not use 100 volt rated parts everywhere? Why not use the nose wheel tires from a Boeing 747 on your Corvette? Because a 100 volt rated capacitor is about 20 times the physical size of a 16 volt rated part of the same capacitance. If the part is being selected for a phono preamp power supply in a circuit application that can never see more than 12 volts, it would be silly to build the circuit and chassis 20 times as big as necessary to do the job perfectly. We want the circuit and its layout to be as tidy and compact as possible.

Years ago Walt Jung "proved" that polarized electrolytic capacitors don't sound good using the grasshoppers cannot hear when all their legs are pulled off method of scientific evaluation. He put electrolytic capacitors in a test circuit and put an AC signal across them. The signal had both positive and negative components. As a surprise to nobody with a knowledge of electrical engineering (but as a surprise to all audio writers and editors of the day) the electrolytic capacitors distorted badly in his test circuit because the negative voltage across the positive terminal of the capacitor caused the capacitor to break down and distort. Guess what, standard polarized electrolytic capacitors are designed to work only when the voltage across them is in the correct polarity (+ voltage to the + terminal, - voltage at the - terminal). If the voltage is reversed, the capacitor breaks down and if the reverse voltage is large enough or sustained, the capacitor will be damaged. They are designed this way because it is possible to make very volume efficient polarized capacitors using this construction technique. The proper design application is power supply storage and other applications where lots of capacitance in the minimum amount of space is required and where the voltage across them will never be reversed. If the power supply in your amplifier was made of plastic film capacitors instead of polarized electrolytic capacitors, it would be the size of a Yugo. However coupling an AC audio signal with no bias voltage across the capacitor is as inappropriate an application for a polarized electrolytic capacitor as is using a little race car tire on the nose wheel of a 747. Unfortunately, what Jung reported was in effect that Gatorbacks are bad tires, rather than the correct observation that this was the wrong application for the part. Jillions of audiotweaks "learned" that electrolytic capacitors don't sound good (shout "jump" at a grasshopper with no legs and you will find it is now deaf - the proof is that it won't jump at all when told to) instead of the correct observation that one should use good engineering judgement when selecting parts for an application. Ever since the world has been filled with purveyors of magic good sounding (and very high priced) parts allowing audiotweaks to diddle up their own equipment all by themselves. They are doing about as much good as buying hearing aids for legless grasshoppers.

(To be continued next month).

Used Equipment Listing

You sharp eyed readers have been snapping up almost everything we have offered just as fast as *Audio Basics* gets to you because our sale prices are really sales and are really special values. We have got a few more special values for you this month too:

We still have four sets of demo B&W loudspeakers in stock at the old sale price. These are not to be repeated values on great performing speakers.

B&W CM1 Mini-Matrix speakers (white only) at $600/pair. They are in absolutely perfect new condition and are seeing temporary

service in my video system and carry a new 5 year warranty.

B&W Matrix 803 speakers (walnut) with our crossover enhancements. These are returns (a doctor thought he could do a critical evaluation of them with a Japanese CD player - like test driving a Porsche fueled with diesel) and they are my main demo speakers right now. They are wonderful sounding, in perfect new condition, have a new 5 year warranty, and are available for just $2400 for the pair. Call us now!

B&W DM630s and DM620s in black ash at our special 20% off price. These are brand new speakers on demo display now and also in perfect condition. They are great sounding (better than KEFs at twice the price) much more transparent than the 500 series B&Ws that they replace and they are 90 dB efficient and easy to drive. At $880 and $640 per pair respectively, we cannot understand why they are still here. Remember we will pay the shipping in the continental USA on any of these and there is no Minnesota sales tax due on anything we ship out of the state.

We still have the Ωmega 150 Control Amp (new circuits, new warranty, used chassis at $695 and the Ωmega upgraded straight line preamp circuits in the used Pat-4 chassis at $195. Don't forget about the music these can give you too.

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