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AMPLIFIER DESIGNER ROUNDTABLE

How have amplifiers improved over the last decade? What is the state of audio amplification today? Have tube sound and transistor sound become more alike? What innovations will the future bring?

To gain some insight into these and other issues, I posed the same set of questions to nine of the world's top amplifier designers. Each of these internationally recognized engineers has produced world-class preamplifiers and power amplifiers, and each takes a different approach to the challenge of creating cutting-edge audio electronics—in some cases, radically so.

—Robert Harley

BOB CARVER / Bob Carver LLC

JOHN CURL / Parasound, Constellation

CYRILL HAMMER / Soulution

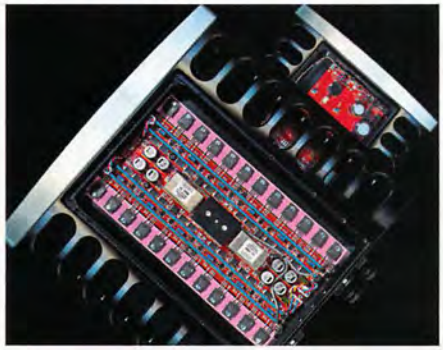
LEW JOHNSON / conrad-johnson design

VLADIMIR LAMM / Lamm Industries

FUMIO OHASHI / BAlabo

NELSON PASS / Pass Labs

JÜRGEN REIS / MBL



JEFF ROWLAND / Jeff Rowland Design

BOB CARVER

We are no longer interested in facsimile reproduction; rather we find that reproduction that sounds enchanting and real is far more interesting and serves our passions far better.

I received my undergraduate degree in physics from the University of Washington and my Master's and an honorary Ph.D. from the University of British Colombia and the UW. I started the Phase Linear Corporation in 1970 to build, market, and sell my first invention, a 700 watt amplifier. After that I started Carver Corporation followed by a small bio-technology company Carver Genetic Physics. Finally, I started Sunfire to build and sell my new invention, the high pressure, high back-EMF subwoofer. I successfully sold each company. My main inventions were the magnetic-field amp, the high-pressure subwoofer, the asymmetrical FM detector, the DC restorer, the dipole woofer system in my panel loudspeaker with a full-range ribbon driver, the autocorrelator noise-reduction system, the tracking down-converter subwoofer amplifier, and the Sonic Hologram. Last year I partnered with Bob Farinelli (former president of Elan) to start a new company, Bob Carver LLC. Our new designs are tube amps with the DC restorer and a floor-to-ceiling line-source speaker.

How much have preamplifiers and power amplifiers improved over the past decade, and why?

What I'm going to say next will fly in the face of much conventional wisdom regarding neutrality, nay, even the desirability of absolute neutrality.

Today, a well designed solid-state amplifier will be all but perfect from a performance and listening perspective. It will have power to spare; it will have nearly a zero-ohm output impedance and a bandwidth far beyond any rational requirement for perfect sound. The protection circuits will not color the output signal when playing speech or music into any rational loudspeaker, and the maximum possible output current will be far beyond the needs of any rational music! This extreme performance will be called upon only from time-to-time when the audio signal is extremely difficult.

The science of solid-state amplifiers has grown enormously over the last several decades. Such an amplifier is expensive though, because delivering this level of performance requires expensive components—big heat sinks to keep it cool, huge power transformers to deliver the current and voltage, as well as massive energy storage associated with the main power supply. I could go on and on, but you get the picture, *n'est-ce pa?*

Have the sounds of tubed and solid-state electronics converged toward a common neutrality in the past 20 years? If so, what accounts for this trend?

Now for the fun! Tube amps! Over the years many tube amps have become more and more like solid-state amps in terms of all the things mentioned above. This has been done quite deliberately on the part of designers as the performance of their amps has improved in many important ways to become as perfect as solid-state amps. Against all odds, it was done with vacuum tubes, a far more difficult job than doing it with transistors, and only a small handful of creative and talented designers have been able to pull it off. Other designers have become so enthralled with the unique and inviting sonic signature of

vacuum-tube amps that they have taken a uniquely different path for great sound. This is evidenced by the many remarkable designs that have very low output power, as well as individual frequency responses and distortion profiles that depend on each speaker they're used with.

What began about ten years ago as an interest in the simple intrinsic nature of tube amps has evolved into almost unbelievably passionate work to extract the most possible realism using vacuum-tube topology. We find that in order to evoke the absolute sound from our tube designs, we are forced to let go of long held and cherished ideas about what an amplifier should do. We find that we are no longer interested in facsimile reproduction; rather we find reproduction that sounds enchanting and real is far more interesting and serves our passions far better. In other words, we listen for something that *could* have been real somewhere in time and space, even if in the moment it's not in our living room. Great tube amps, against all odds, can deliver music with a majesty and sweetness that is truly difficult to believe.

You choose to work today with tubed amplifiers. What are the advantages you see to your chosen technology?

I design amplifiers with tubes as well as transistors, and in each case I have built my amplifiers so they present a musical performance that could have existed in another time and space. Since we are not there in that time and space, we can only infer that it represents the real world, and the best we can know is that the sound we hear is deeply satisfying and very moving. That's the secret.

Is Class D competitive with linear designs in sound quality, and if not, will it ever be?

For over twenty five years I have waited for Class D amplifiers to come of age. Each year I read the many scientific papers on the latest developments in switch-mode amps, and could not help but believe that just around the corner the promise of great sound and cool efficient operation would come true. I built many of them right here in my own laboratory with the thought they could and would fulfill that final promise. I was never able to build a Class D amplifier that sounded as good as a linear one. There are several obscure, yet easily understood reasons for this, and just as soon as I find the time I plan to return to my latest switch-mode design and try one last time before this year is finished! I have not given up yet.

Has amplifier design reached its zenith where further improvements are marginal, or will the next decade produce even better-sounding preamplifiers and power amplifiers?

Your last question is the most intriguing one for me; has our amplifier science reached its zenith? Of course not. There is always that next step; everything changes in science and audio, and the next amplifier design changes everything.

Some version of hybrid Class A and Class D looks like the future in optimum audio design.

John Curl has been designing high-end audio electronics almost since there was an American high-end. He earned a degree in Physics with a minor in Electrical Engineering in 1966. After designing the sound-reinforcement system for the Grateful Dead in the late 1960s, he worked as a design consulant to Mark Levinson Audio Systems where he created, among other products, the seminal JC-2 preamplifier. He has spent the last 40 years as a design consultant to a number of high-end companies including Parasound, Audible Illusions, and Constellation Audio. His Vendetta Research SCP-2 phonostage is considered one of the great breakthroughs in phono reproduction.

How much have preamplifiers and power amplifiers improved over the past decade, and why?

Preamplifiers and power amplifiers have only modestly improved in quality over the last 10 years, at least the analog designs that I work with. The reason is the limitation of development of even more advanced active devices that can be utilized for superior audio products. In fact, most active devices normally used in audio have been discontinued, and poor quality or expensive equivalents have been introduced to replace them, instead. IC's have evolved, but not in any revolutionary way, in my opinion, for the last 10 years.

Have the sounds of tubed and solid-state electronics converged toward a common neutrality in the past 20 years? If so, what accounts for this trend?

I think it is mostly improvements in the power supplies and the capacitors used for both tube and solid-state products that make the difference, and make tubes and solid-state actually sound more similar.

You choose to work with solid-state amplifiers. What are the advantages you see to your chosen technology?

I choose to make solid-state analog circuitry, exclusively. I design Class A if possible; Class AB for a power amp output stage is most practical. I just push the limits as much as I can without overheating.

Is Class D competitive with linear designs in sound quality, and if not, will it ever be?

Class D has improved considerably over the last ten years. Some version of hybrid Class A/D looks like the future in optimum audio design. For me, I will stick mostly to analog, but in future, we will run out of quality audio parts and some version of Class D will be necessary.

Has amplifier design reached its zenith where further improvements are marginal, or will the next decade produce even better-sounding preamplifiers and power amplifiers?

No, amplifier design continues to be improved on. When we ultimately go to hybrid Class A/D designs, we will have both relatively light weight, high power, low heat, high efficiency, and extremely high-quality audio designs that will win listening contests, much like sophisticated turbocharged auto engines have replaced the muscle car engines of the past.

CYRILL HAMMER

We are deeply convinced that the technically better amplifier–this implies also better measurements results–does sound better.

Cyrill Hammer was born 1965 in Switzerland and earned Master of Science in Electrical Engineering and Economics degrees at ETH Zurich. Before he joined his family business (Spemot AG) in 2002 Cyrill was active in several management positions for Swiss SMEs and as a business consultant with BCG, focusing on strategic repositioning of major financial services institutions and telcos. Within Spemot he manages and develops the new business unit, Soulution.

How much have preamplifiers and power amplifiers improved over the past decade, and why?

We have seen a tremendous improvement over the last ten years. New companies like Soulution have introduced unconventional, innovative, and better approaches to resolve several technical issues of the amplification process that have never been considered before.

Have the sounds of tubed and solid-state electronics converged toward a common neutrality in the past 20 years? If so, what accounts for this trend?

The understanding of how a high-end system should sound has considerably evolved. New products which have pushed the envelope showed that there is more to be expected from amplifiers than the old stereotypes of solid-state products being powerful but less musical, whereas tube amplifiers are claimed to be more natural sounding but are lacking control over the speakers. These products have clearly shown that all relevant virtues of the two approaches can be combined in one product without compromising in any dimension of sound reproduction. Over time, customers will get used to this new quality of listening and will generally expect that from products participating in the market. This automatically raises the bar in performance for all manufacturers and heavily fosters the convergence of solid-state and tube electronics.

You choose to work exclusively in Class AB solid-state. What are the advantages you see to your chosen technology?

Taking into consideration all aspects of amplification we are convinced that a properly done solid-state design is superior to its tube-based counterpart. We are deeply convinced that the technically better amplifier—this implies also better measurements results—does sound better. However, good measurement results, which are quite easy to achieve with solid-state amplifiers, do not in and of themselves automatically guarantee superior sonic results. Most measurements performed today for the assessment of audio components are done in the frequency domain. It is, of course, most important to have perfect behavior here, but it is only half the truth. Perfect performance in the time domain is no less important. This is especially true of amplifiers based on negative feedback. The theoretical concept of negative feedback is very powerful, and the simplified mathematical equations describing this concept do hold true. But they are only valid if the design addresses

the limitations of the concept. The time delay from input to output must be zero! Obviously in real life this is not possible. There are two ways to deal with this problem. Either you just do not apply any negative feedback at all to your design (while giving up the advantages of the concept) or you do speed it up to the level (200MHz in the case of the Soulution 700 and 710) of a few nanoseconds of time delay from input to output, where timing errors are so small that they do not have any audible impact on the sound. Once you decide to go the latter way a whole bunch of new challenges suddenly arise. Thermal conditions, stability of supply voltages, high-frequency designs, noise induction etc., etc. With tubes as active components such designs would never ever be controllable and stable; they must be done with solid-state devices. The result of such a project is a product that seems to be ridiculously complex vis-a-vis the "simple" task of amplifying "slow" music signals. We at Soulution strongly believe that all of this is required to perform this task the best way possible.

Is Class D competitive with linear designs in sound quality, and if not, will it ever be?

Several companies have already shown that it is possible to design Class D amplifiers with decent sound quality. However, if you want to have your product performing at the cutting edge it is not possible with today's known switching technologies. In order to come close to the performance of the best linear design we would need high-current semiconductors that provide switching frequencies of several MHz or even GHz. Even if this kind of semiconductor could become available at some point, such a design would still require a low-pass filter in the output with a cut-off frequency of about 0.5–1MHz and that also passes current peaks greater than 40 Amperes. Such a filter is not impossible to design, but would be very demanding and expensive.

Has amplifier design reached its zenith where further improvements are marginal, or will the next decade produce even better-sounding preamplifiers and power amplifiers?

The best preamplifiers available today offer residual noise and distortion levels that are really minimal. We see some potential to further reduce the noise floor resulting in better soundstaging, and also in reducing harmonic distortions. This will lead to even more natural and realistic sound quality.

The design of a power amplifier is much more demanding. There has been more margin for improvement here and there still is. The Soulution Series 7 amplifiers were a real quantum leap when we introduced them in 2005. I do not expect that another improvement of the same magnitude will be possible; however, it could be quite substantial. We are currently working on several areas involving the power supply of these amplifiers with quite promising potential for improvement. Today we do not know when this new technology can be introduced to the Series 7 amplifiers. In any case there will be an upgrade path for existing products owners.

LEW JOHNSON

The sound of the very best tube and solid-state electronics is converging. This is not surprising because among serious audio designers there is a common goal of reproducing a musical event.

Lew Johnson - Bachelor of Chemistry, University of Minnesota 1968; Bachelor of Arts, University of Minnesota 1968; Ph.D. Economics, University of Washington 1972. Co-founder of conrad-johnson design, inc. 1977. Musical instruments attempted: clarinet, banjo, electric bass; mastered: none. Active in the audio industry for over three decades, both in private capacity as co-designer, co-owner at conrad-johnson, and in leadership positions in industry associations (AAHEA, CEA).

How much have preamplifiers and power amplifiers improved over the past decade, and why?

At conrad-johnson, we have made significant progress in the past decade. Circuit refinements have offered significant improvements. In preamplifiers, a new approach to the basic circuit design has enabled us to build on the quantum change in performance that we managed back in 1996 with our ART preamplifier. In amplifiers, ongoing improvements to the voltage-gain stages have resulted in more evolutionary progress. Much of the improvement in the last decade is attributable to the proprietary Teflon dieclectric capacitors that we helped develop, which have found application in both our amplifiers and preamplifiers. Unfortunately, these capacitors are very costly, limiting their application to higher-end products. We introduced these capacitors in our top models starting in 2003. We find that in recent years, a few other manufacturers have also begun to use similar capacitors.

Have the sounds of tubed and solid-state electronics converged toward a common neutrality in the past 20 years? If so, what accounts for this trend?

The sound of the very best tube and solid-state electronics is converging but with some ways to go yet. This is not surprising as among serious audio designers there is a more or less common goal of reproducing a musical event. There remains, however, some difference in approach between those who, like ourselves, seek to honor the musical performance (trying to preserve the emotional element of the music) and those who seek to replicate the "objective" details of the recording (tending to focus on minimizing distortion, maximizing bandwidth, etc.). Presumably the intent of the recording is to honor the musical performance, so ultimately these come to same objective, though from a somewhat different angle. I think this difference in approach accounts as much for the differences in character among electronics as the technologies employed.

You choose to work primarily in tubed circuits. What are the advantages you see to your chosen technology?

At conrad-johnson, we have worked in both tube and solid-state circuits, though certainly with tubes to a greater extent. Tube circuits offer several advantages. First, the size, heat dissipation, and cost of the devices tend to dictate relatively simple circuits, and our experience is that simple circuits sound better. Second, tubes are inherently superior voltage-

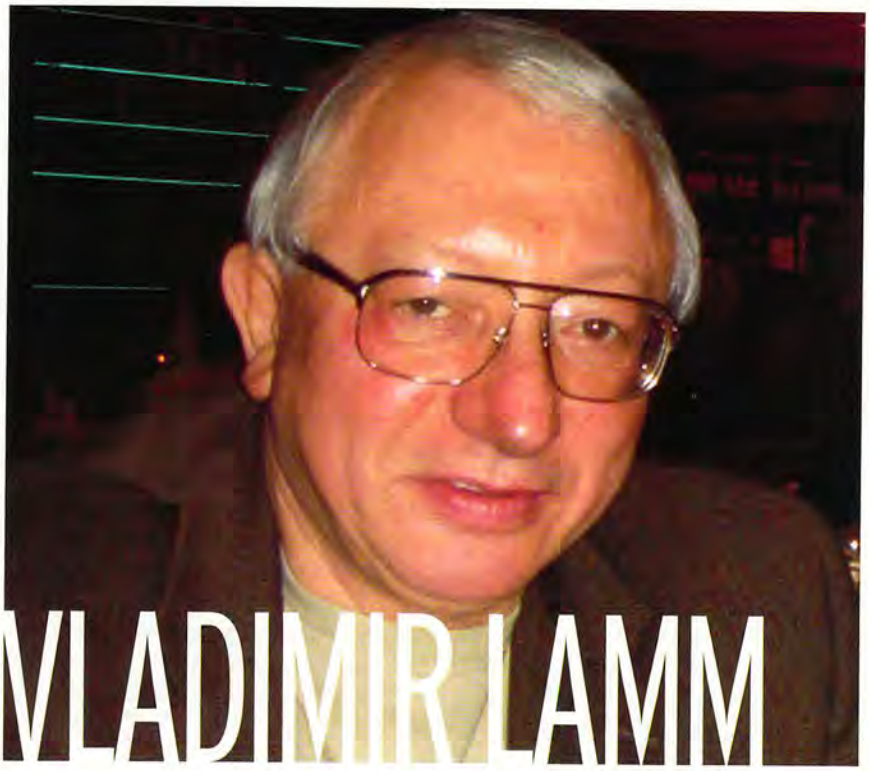
amplifying devices. Typically a tube voltage amplifier with no feedback is roughly an order of magnitude more linear than a solid-state device (the transfer function is about 1/10 as curved). This is simply because they operate comfortably at much higher voltages, making the output voltage a much smaller percentage of their range (a shorter segment of a curve is a better linear approximation than a longer segment). To get around this problem, transistor circuits usually involve more elaborate circuits (see first point above) with more devices and heavy-handed application of negative feedback which has its own drawbacks. Finally, vacuum tubes produce predominantly even-order distortion, which is musically related to the original tone and thus unobtrusive. (FETs share this property with tubes, but, like bipolar transistors, are less linear than tubes.) That said, I personally believe that the greatest strides in amplifier circuits will be in hybrid circuits with solid-state devices employed to do what they do best (current gain). We have had already had considerable success with such circuits.

Is Class D competitive with linear designs in sound quality, and if not, will it ever be?

I tend to think that Class D circuit design is an approach best relegated to producing low-cost, physically manageable multichannel amplifiers—where one might accept some compromise in sound quality for the sake of squeezing five, six, or seven 100 watt channels into one moderate-sized package for a budget home-theater installation.

Has amplifier design reached its zenith where further improvements are marginal, or will the next decade produce even better-sounding preamplifiers and power amplifiers?

On more than one occasion I have thought that we had reached the zenith of design and that further improvements would only be marginal in nature. In each case this period of malaise was soon followed by truly exciting breakthrough developments resulting from new materials technology and new insights into circuit design. There is ample historical precedent for this kind of self-deception. In the early 1900s, the Edison company conducted live vs. recorded demonstrations of its new Edison Diamond Disc recordings played back on spring-motor-driven Edison acoustical phonographs. Listeners swore they could not distinguish the live performance from the recorded one, implying that any further improvements would be marginal. We see that position as laughable today, even though it recurred in the 30s, and in the 60s, and with "perfect sound forever" in the 80s. In reality, it is still the case that playback of a recording rarely fools the careful listener into perceiving it as live. There is still plenty of room for improvement throughout the audio chain and no doubt we will continue to see that improvement in the coming decade.



VLADIMIR LAMM

The advantage of single-ended topology using triodes lies in the real possibility of achieving the level of sound reproduction that closely approximates the actual sound of live instruments in space.

Vladimir Lamm was born in the former Soviet Union and holds an M.S. in Electronics and Solid-State Physics. He was a professional table-tennis player; for many years played in a symphony orchestra; was involved in the Russian Space Program; studied psychoacoustics in depth; developed a theory called Absolute Linearity of the System, on which his audio designs are based with predefined and predictable parameters (eliminating the need for a trial-and-error approach to design). Founded Lamm Industries, Inc. in 1993.

How much have preamplifiers and power amplifiers improved over the past decade, and why?

I believe that I have dealt with this question to some extent in my answers to questions 2 and 5. I would just like to note that in light of a very rapid growth marked by the proliferation of increasingly affordable digital technologies, audio equipment has been enriched with various features, the implementation of which would've been quite problematic as recently as 15–20 years ago due to price and overall dimensions.

Have the sounds of tubed and solid-state electronics converged toward a common neutrality in the past 20 years? If so, what accounts for this trend?

Partially. The improvements that have been made on this path are in generally related to a couple of aspects: (1) a growing understanding of the necessity to re-examine the role of feedback in the audio path, with such awareness itself already providing an opportunity to scratch at least the tip of the iceberg; and (2) a gradual realization by the engineering community that the interaction between a man and a sound-reproducing system takes place on many levels—those that have already been studied and supposedly understood, as well as those that are largely unknown and mostly hidden from us for the time being.

You choose to work primarily in tubes, but you have produced single-ended tube and solid-state Class AB designs. What are the advantages you see to each of these technologies?

I am working with tube, solid-state, and hybrid technologies utilizing single-ended (Class A) and push-pull (Class A and Class AB) topologies. However, my personal preference is for the single-ended topology that employs vacuum triodes in the output stage. The advantage lies in the real possibility of achieving the level of sound reproduction that closely approximates the actual sound of live instruments in space.

Is Class D competitive with linear designs in sound quality, and if not, will it ever be?

No, it is not. And I would like to respond to the second part of this question with an allegory. Any field of human activity defines a number of requirements which, when properly implemented, guarantee a positive outcome. For example, the basic requirement in the army and sports is an able-bodied individual. So, it would be quite natural to concentrate on searching for such an individual (especially as we know where to find him). However, out of the blue we decide to choose a feeble-

bodied person who, on top of that, is encumbered by various diseases. Having made this decision (which is *a priori* improper) we start justifying it to ourselves and others by citing the great state of our medicine, which is capable of curing many ailments.

Of course, this allegory illustrates the utilization of Class D topology in high-end audio only. There are many technical applications in which implementation of high-efficiency power amplifiers is not just very desirable but sometimes *the* only reasonable solution.

Has amplifier design reached its zenith where further improvements are marginal, or will the next decade produce even better-sounding preamplifiers and power amplifiers?

For the sake of brevity, I will once again use an allegory. We know the names of great masters—Amati, Guarneri, Stainer, Stradivari, etc.—who became universally known and respected for their unparalleled creations of bowed string instruments. These instruments have passed the test of time, which is generally a determining factor in evaluating the real worth of any object and/or idea. In this day and age, while possessing very impressive scientific and mathematical knowledge, along with access to powerful technologies, we nonetheless can only approach the previously accomplished mastery level when producing the same type of instruments.

Please note that whether we are talking about musical instruments or electronic audio equipment, we are dealing with devices that interact with the human structure itself—in all its complexity. I think that if future research in the field of high-end audio will take this—and all related factors—into consideration, and begins work in this vein, we can expect very interesting and serious results.

Simply put, solid-state (vs. tube) offers the designer finer control of the musical signal. This is particularly valuable in music with complex waveforms such as classical.

I built my first amplifier in junior high school. Back then, it was about my love of music, as it is today. After majoring in electronic engineering, I worked at Nagaoka, a manufacturer of phono styli and head amplifiers. There I learned about signal conveyance at extremely low levels. Eight years later I went to Luxman and after another twenty years, became Luxman's chief engineer. It was great preparation to start BAlabo where "Sky is the Limit" is our maxim.

How much have preamplifiers and power amplifiers improved over the past decade, and why?

A great deal. Why? Because it was ten years ago we founded BAlabo! But seriously, you can observe that many of the companies at the extreme high end have been founded within the last decade. There is probably not a precise metric to quantify "how much" other than to say that improvements have been realized across the board in resolution, musicality, usability, and aesthetics.

At BAlabo, we have endeavored to push our vision of what is possible in each of these areas. Although analog circuit design has evolved very little in the past 30 years, there is much room for improvement in implementation of these circuits. Interestingly, and this is a key point, *improvements in specifications do not always equate to better sound.* Therefore, not only do we measure, *we listen.* Individual parts selection is done by thousands of iterative listening trials. Our process includes tireless examination of materials, including lead length and gauge in every resistor, capacitor, transformer, and hookup wire. In the end, every single part inside our components is custom-made. We have nurtured our relationships with parts manufacturers to get exactly the products that we specify. Then there is circuit topology. Best practices in shielding and micro-signal grounding are widely observed, but the designer's experience and intuition still play a dominant role. Altogether, the fine-tuning process, even after the main circuit and chassis designs are complete, takes us two to three years.

This extreme effort is devoid of the primary concern that many "established" manufacturers must live by—keeping the cost of the parts low. That's not a primary consideration at BAlabo. The result is a component that offers an audio experience unique to our brand, that cannot be copied or imitated, and can be immediately appreciated by the discerning audiophile.

Have the sounds of tubed and solid-state electronics converged toward a common neutrality in the past 20 years? If so, what accounts for this trend?

Yes. I believe that the *primary* principle that guides this convergence is the designer's prowess combined with his ability to judge good sound, whether tube or solid-state. Personally, I'm not a fan of either the 300B or KT-88 tubes.

You choose to work primarily in solid-state Class AB. What are the advantages you see to your chosen technology?

Simply put, solid-state (vs. tube) offers the designer finer control of the musical

signal. This is particularly valuable in music with complex waveforms such as classical. Even the best tube designs begin to have difficulty with full-scale orchestral and symphonic music. This is most evident in power amplifiers, as most listeners know, but during critical listening, even tubed preamplifiers will fall short of the best solid-state in control, structure, and individuation of instruments in a large and complex soundfield.

We chose Class A transitioning to AB because it offers the best of each technology. Class A improves low-level crossover distortion and Class AB offers vigorous sound quality with explosive dynamics. Guided first and foremost by sound quality and after many listening trials we decided on the optimal "crossover" point for the handoff between Class A and AB. Interdependent variables include the size of the power supply, the amount of current used in the output stage, and the type of output devices. These all react dynamically with one another and must be carefully designed in harmony and with ample headroom. The larger size and heat dissipation characteristics of pure Class A designs were considered negative factors in targeting a 500Wpc amplifier.

Is Class D competitive with linear designs in sound quality, and if not, will it ever be?

No. Class D can't really be considered for super-high-end performance in its present stage of development, although it can be fine for mid-market products. In the future Class D may have some promise if the carrier signal can be stripped away without affecting the sound quality. This could mean larger and heavier devices in the output stage though—thus defeating some of the practical advantages of Class D.

Has amplifier design reached its zenith where further improvements are marginal, or will the next decade produce even better-sounding preamplifiers and power amplifiers?

There is no limit to performance improvement in the analog world. An engineer should always aggressively pursue better sound and *never* consider a design to have reached its zenith.

There are still many conditions that are not readily measureable that affect the quality of sound. In the future, one thing I would look toward is the ability to control the direction of spin of the electron. This level of control would help to eliminate some of the random variations we hear when similar parts sound different from one another.

On a related precursor, the recording industry should also take drastic measures to improve the signal conveyance chain through the mastering process in order to preserve the signal between source and consumer storage media. Once signal integrity is lost, it can never be restored no matter how good the playback devices.

NELSON PASS

The last ten years have once again demonstrated that high-end amplifiers with part-per-million distortion numbers and other superlative specifications are not very popular. It's like pure distilled water–it has no character and most people don't want to drink it.

How much have preamplifiers and power amplifiers improved over the past decade, and why?

The last ten years have once again demonstrated that high-end amplifiers with part-per-million distortion numbers and other superlative specifications are not very popular. It's like pure distilled water—it has no character and most people don't want to drink it.

If there has been progress, it has been where the subjective character has been refined in the service of the listener's experience. To paraphrase McLuhan, we are turning our mature technologies into art.

Have the sounds of tubed and solid-state electronics converged toward a common neutrality in the past 20 years?

No, just the opposite. Anything resembling convergence to objective neutrality occurred in the late 60s and early 70s, and since then tubes and solid-state have diverged, catering to different needs and tastes. Tube preamplifiers have assumed a popular role—warming up the sound when mated to a solid-state power amplifier. You could speculate that this results in a subjective neutrality in the ears of the listener.

You choose to work primarily in solid-state/single-ended Class A. What are the advantages you see to your chosen technology?

At some point in the past I lost interest in complex amplifiers, so now I enjoy extracting really good sound from simple amplifiers. This naturally leads to solid-state Class A, where I can make a good-sounding low power amplifier with as little as a single FET and a light bulb.

And I do.

Is Class D competitive with linear designs in sound quality, and if not, will it ever be?

Does a $10 bottle of wine compete with a $100 bottle? Of course it does, and it often wins based on price. Right at the moment Class D designers seem to be still focusing on the objectively measured performance of their amplifiers. I expect that at some point the economics of the marketplace will encourage them to pay more attention to the subjective qualities, and then they will probably play a greater role in the high end.

Has amplifier design reached its zenith where further improvements are marginal, or will the next decade produce even better-sounding preamplifiers and power amplifiers?

I am optimistic. I think the power amplifiers will be mine, and the preamplifiers will be Wayne Colburn's.

JÜRGEN REIS

When speaking about the top high-end companies, you can say globally that tubed electronics are more neutral and solid-state electronics are more coherent and less sterile than twenty years ago.

Jürgen Reis has always played and listened to music. At University, he studied Electro-Acoustics and Electrical Engineering. Jürgen became Chief Engineer at MBL in 1984 when he invented the carbon-fiber radial tweeter. Since then, Jürgen has been responsible for the technique and sound of all MBL products. 2012 marks his 30th MBL anniversary. Jürgen doubles as a recording engineer (in the studio he built), shreds on electric guitar, sings in a chorus, and cycles.

How much have preamplifiers and power amplifiers improved over the past decade, and why?

Wow. Broad question. Volumes have been written about this. Simply put, I think this is a secondary benefit of the great improvements in loudspeakers and some recordings, and these two facts have given engineers better tools to improve the quality of preamplifiers and power amplifiers.

The very, very small parts make a huge difference, especially in the preamp—for example, a resistor with brass, copper, or steel "holders." Today you can hear large differences between small parts and their construction materials that were not so easily apparent ten or twenty years ago.

Have the sounds of tubed and solid-state electronics converged toward a common neutrality in the past 20 years? If so, what accounts for this trend?

Yes they have. When speaking about the top high-end companies, you can say globally that tubed electronics are more neutral and solid-state electronics are more coherent and less sterile than twenty years ago. The differences between them are shrinking.

Why? Designers have much more experience now than ever before, and both sides are listening to the other's electronics—tube guys listen to solid-state and vice versa.

You choose to work primarily in solid-state Class AB. What are the advantages you see to your chosen technology?

Bigger question! I work in lots of techniques, A, AB, now Class D, as well. I have two main reasons why I don't like to work with tubes. MBL products are designed so that our customers have a long enjoyable time with their gear, and changes come slowly and carefully. Tubes are constantly aging and changing over time, and the differences between several tube manufacturers and factories are large—even today—so any time they change the manufacturing spec, tooling, material, etc. the behavior and sound will change and I would have to completely change my design to accommodate the change in the tube to maintain the sound I want the customer to enjoy.

Also, with tube designs you mostly have transformers at the output and often at the input. Transformers have a huge influence on the sound quality. Quality control of transformers is very difficult to maintain, so that next year you get the same iron and copper on the windings as you did this year or last year. It's much more difficult to have a tube amp sounding the same this year and last year, if you are planning for a constant sound.

With solid-state, the circuits are more repeatable. You can better control the quality, so next year's products will sound very similar to or the same as last year's. This stability is the main reason I choose solid-state.

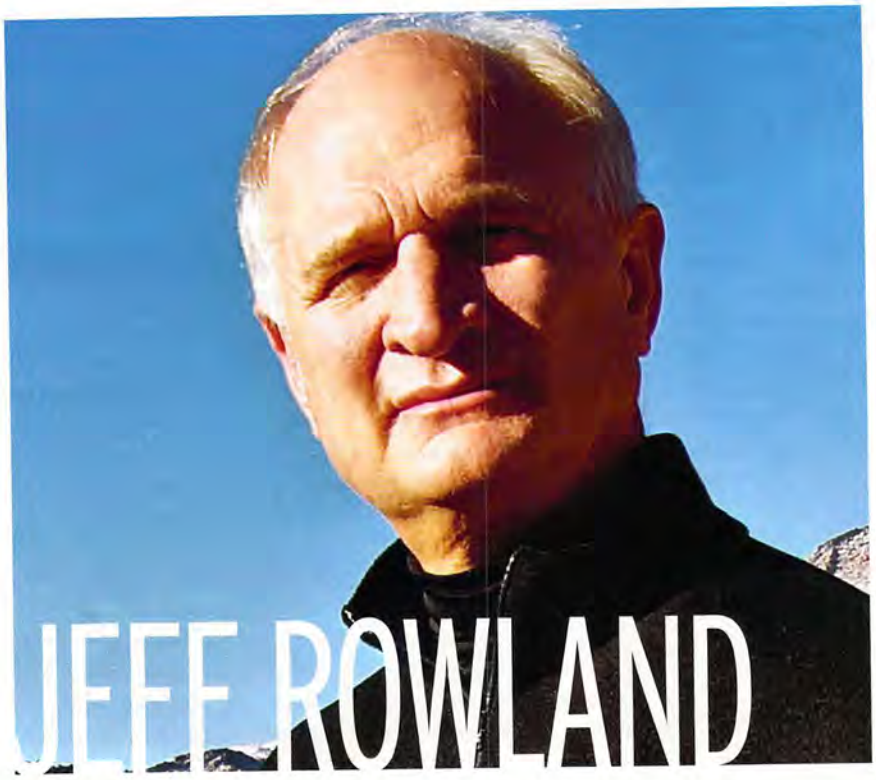
Between classes, you must understand the principal differences. Roughly, if you can comprehend what causes the main differences, you can build a "hybrid" of Class A and Class AB. MBL preamps run Class A up to 7 volts, and in our Reference power amps the signal quality is determined by Class A, and is sort of "swimming" on a Class AB power supply. I prefer the sound of Class A, but you can design Class AB circuits that sound similar at high and low levels. With solid-state vs. tubes, you have different circuitry for the plus and minus, and this always sounds different when you change the polarity of the sinewave. With Class A, you don't have the differences between positive and negative voltage swings. With PNP and NPN transistors you always face the problem of dealing with different times of charge and discharge; in one direction you always have too much current, the other, not enough. With Class A, you eliminate this crossover.

Is Class D competitive with linear designs in sound quality, and if not, will it ever be?

I have worked a lot lately with Class D. Ninety-nine percent of Class D circuits are not competitive with linear circuits. There are some exceptions and, of course, I like to think the new MBL Corona Line is one of them. At CES this year, I heard a few other Class D designs that I thought sounded good. In three years, we might have five-percent sounding okay and ninety-five percent sounding poor. Look at solid-state thirty or forty years ago—it sounded awful compared to tubes. We had no idea why the tubes sounded more "pleasant" to the ear in some areas, even though they had 100 times the distortion. It took many years to understand. Only companies that deal with both sides can develop an understanding. Most Class D sounds sterile. It's tricky to figure out what to do to compensate for that.

Has amplifier design reached its zenith where further improvements are marginal, or will the next decade produce even better-sounding preamplifiers and power amplifiers?

The next decade will produce better-sounding preamps and power amps, but perhaps not as large-scale different as in past decades. I am always working on something better, more natural, more human, more coherent, more lifelike.



Strict adherence to a class designation for an audio designer is like asking a painter to reduce the number of colors on his palette. The end result may be less vivid than you had hoped for.

"How does this work?" Asking this question, at age 12, led to my lifelong devotion to uncovering the mysteries of electronic design. My background includes working as an engineering assistant with Ampex Corp. and studying electronic engineering at the DeVry Institute. I formed Rowland Research in 1981 which became Jeff Rowland Design Group in 1987. Since then, I have developed more than 35 critically acclaimed audio components that are now enjoyed by countless listeners around the globe.

How much have preamplifiers and power amplifiers improved over the past decade, and why?

First, let me thank *The Absolute Sound* for including me on this august list of designers. I consider it both an honor and a privilege.

I've been an audio designer for 40 years and never in that time have I felt a greater sense of promise for the future of high-end audio. Recently, it's been my pleasure to hear a number of sound systems I believe are approaching true greatness in audio reproduction. The possibility that audio components may soon capture all the emotional power of live music is a dream never closer to being realized.

Our reference system at Jeff Rowland Design Group is revealing to such a degree that it seems eerily capable of transporting the listener to the musical event itself. Understand, our reference system is a collaborative work, featuring components and design ideas from a wide range of audio engineers. With our continued collective devotion to musical fidelity over time, I see no limit to the compelling listening experiences yet to be enjoyed.

There are many purely technical reasons audio designs are improving. For example, my company's current designs benefit greatly from electronic parts unavailable until quite recently. However, it is also true that designers themselves, in this relatively young industry, have grown more mature and capable.

New components, technologies, and design concepts are just pieces of a greater puzzle. It takes years to understand the complex relationship between component parts and the end product. Audio design is an art form that requires a lifetime to master. There are no shortcuts.

Have the sounds of tubed and solid-state electronics converged toward a common neutrality in the past 20 years?

I believe there is a trend toward the creation of a more natural representation of the original performance. This seems to represent the overarching aim of all audio designers, whether working with tubes or solid-state. We are all trying to climb the same mountain. Our paths may be different, but I believe we certainly respect one another's efforts.

You choose to work primarily in solid-state Class AB and in Class D. What are the advantages you see to your chosen technologies?

Over my career I have designed using a wide variety of technologies. I prefer to believe that my work displays a willingness to explore audio design regardless of class designation. While my basic design goals seem best suited to the solid-state domain, I am not overly concerned about

which class of technological platform I work within. You might say I am a proponent of the classless society of audio design, taking the best that each has to offer in an attempt to create the finest components possible.

Is Class D competitive with linear designs in sound quality, and if not, will it ever be?

I consider Class D to be highly competitive in the present, and to offer an evolutionary pathway of audio design that may produce even more astonishing results in the future. Again, it is not a matter of class distinction. The application of technology is what is important. It can produce brilliant or poor results depending on its implementation. Strict adherence to a class designation for an audio designer is like asking a painter to reduce the number of colors on his palette. The end result may be less vivid than you had hoped for.

Has amplifier design reached its zenith where further improvements are marginal, or will the next decade produce even better-sounding preamplifiers and power amplifiers?

Although high-end audio is a relatively young industry, many high-end products from mature companies have achieved our longtime shared objectives. These current products are beautiful and reliable, and offer exceptionally high performance and pride of ownership.

However, I'm confident that much remains to be discovered. Engineering is a discipline that seems to move in fits and starts. There are slow periods followed by incredible breakthroughs. Science and art have always been restless bedfellows, but when they come together it can be breathtaking and worth the wait. We can never truly appreciate the next level of art and design until we actually arrive.

The passion for discovery is a silent but powerful motivator for both science and art. The art of engineering is especially exciting as we have the opportunity to daily manifest abstract ideas into reality. Through our passion for our work we can hope to inspire the next generation of designers and listeners on their own journeys to musical revelation.