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# Amplification Components

**PART 2**

## AMPLIFIERS

by Richard Hardesty

*An audio system won't work without an amplifier and it can't provide musical satisfaction unless that amplifier produces great sound. The amplifier is one of the most important components in an audio system. This vital link is often given insufficient attention when audiophiles listen to components or it is allotted an inadequate portion of the total system budget. Understanding how an amplifier works can make its importance easier to appreciate.*

Audio amplifiers can be a huge speed bump on the road to musical satisfaction. The amplifier can make or break an audio system even if your source component retrieves every piece of information from the recording and your speakers are perfect. The signal that drives your speakers is a facsimile of the recorded information, which mimics the original but is actually created within the amplifier.

All competently designed amplifiers don't sound the same. You can't have great sound without a great amplifier!

### A Better Example

Equipment reviewers often describe the perfect amplifier as a "straight wire with gain." This is somewhat misleading because it causes the reader to envision a small signal that is somehow made bigger. An amplifier does create a powerful output signal from a small input voltage but not in the way many imagine.

The input signal is actually used to modulate the amplifier power supply. Comparing an amplifier to an enlarging copy machine would provide a better analogy of the actual process. The signal you hear from your speakers was created by the amplifier power supply. It is a large replica of the small amplifier input signal. The quality of that replication is vitally important to the sound you hear.



### What's in This Journal?

This **Journal** will not attempt to teach you how to build an amplifier. It will attempt to help you choose one to buy. Although I can repair a broken amplifier and I have a basic understanding of what amplifiers do and how they do it, I am not qualified to design an audio amplifier circuit or tell you exactly how it's done. If you want to learn how to select the best amplifier for your system I have something even more valuable to offer.

Years of selling and servicing audio components have afforded me a unique opportunity: I have listened to a remarkably large number of amplifiers using a remarkably wide variety of speakers. Many of these products came home with me and remained there for an extended period of time. My practical experience with audio amplifiers is broader and more varied than that of any designer I know. It can be useful to you and I'll share my impressions of different design features as we discuss their merits and deficiencies.

This **Journal** will provide technical information that will help readers to understand amplifiers, and offer subjective impressions of the sonic characteristics of various amplifier types. This will help to narrow the field of choices and make listening comparisons more meaningful.

After I describe some of the design features that distinguish amplifiers, I'll tell you how most of the amplifiers of a particular type have sounded to me. Then Shane and I will offer full reviews of specific examples of some of these amplifier types and we'll tell you what we heard while evaluating the performance of these products head-to-head.

Nothing you'll read here is meant to suggest that you can choose an amplifier without listening comparisons, but there are dozens, perhaps hundreds, of amplifier models to choose from and few people will have the time or opportunity to listen to them all. Learning a little about how amplifiers work and studying the specifications can help to narrow the field of potential candidates and limit the number of listening experiments.

Certain design choices, like bipolar versus FET transistors, or solid-state versus tube output devices, will often define the most suitable amplifier type for the job. Readers can study the information provided here and in the manufacturer's specifications and then listen to a few examples of the various amplifiers and decide which design characteristics are likely to produce the most pleasing sound in their specific systems. The final choice can be made during listening comparisons, preferably at home.

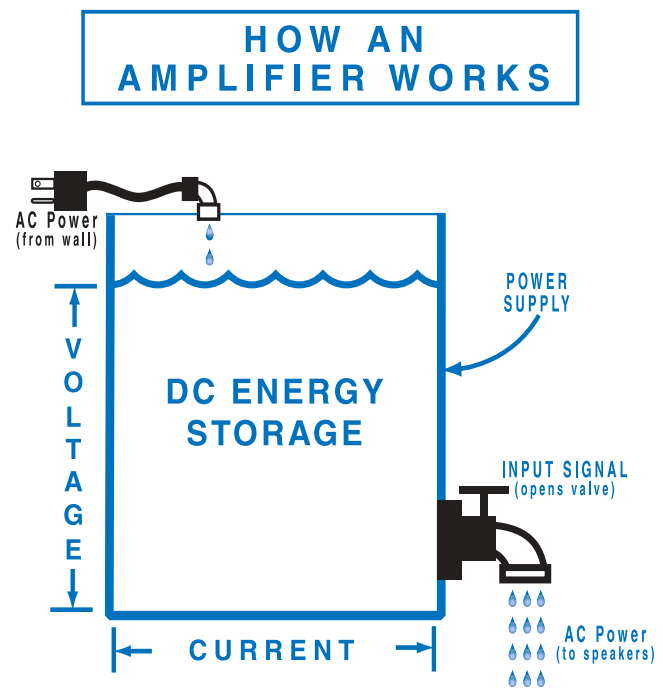
All the information presented here will be generalized and simplified. Nothing you'll read here is absolute (except Ohm's law) and you are likely to find exceptions to many statements. A complete set of absolute rules would make for a dull universe and a less exciting hobby. General concepts can, however,

help to simplify the selection process and prevent expensive mistakes.

## Two Purposes

An audio amplifier must perform two primary jobs: it must deliver sufficient power to drive the loudspeakers to a suitable level in the listening room and it must provide good sound. These jobs are closely intertwined in a real amplifier. An amplifier that's not quite powerful enough is not likely to sound as good as it could because it will be frequently overdriven.

Amplifiers that are straining to produce enough power sound hard and then distorted as the output waveform is "clipped." The amplifier must be sufficiently powerful so that it is operat-



ing within its limits most of the time in order to minimize this distortion.

After you have established a minimum level of real power for your needs you can concentrate on sound quality. You'll want an amplifier that can perform capably and produce the best sound that your budget will allow.

Different types of amplifiers have different sonic attributes and different power capabilities. In our discussion of amplifiers we're going to separate these jobs in order to simplify and clarify the

explanations, not because they can be separated in real life.

Let's start by defining some terms so that the explanations make sense. **API**

### *an introduction to...* **AMPLIFIERS**

by Richard Hardesty

*Here are some descriptions of, and an introduction to, the terms that will be used in this **Journal**. To describe an amplifier you must first define a signal and what the amplifier does to that signal.*

#### Signal

The signal is the electrical form of the information that you want to produce acoustically. The input to an amplifier is a small voltage often referred to as a "line level" signal. Most amplifiers can be driven to full output by an input signal with amplitude of about 1-1.5 volts into high impedance. Amplifier input impedance will typically fall between 10k $\Omega$  and 100k $\Omega$ . Little current will flow into such high impedance.

The output from an amplifier is a higher voltage level that can produce substantial current flow through a typical low impedance speaker load of 4-8 ohms. Power, measured in watts, is the product of voltage and current (see **Journal** #10). An amplifier that produces 100 watts into an 8 $\Omega$  load should deliver about 28 volts with 3.5 amperes of current. This output signal has power that can perform work like transforming electrical energy into acoustic energy (sound) by compressing and rarifying air.

#### Sections of an Amplifier

There are many amplifier designs and some work very differently from others. For the sake of discussion we'll separate the amplifier into several sections: the power supply, which usually includes a transformer, rectifier and storage capacitors; the input or transconductance section, which usually prepares the line level signal for gain; the gain section, which makes an enlarged replica of the signal; and the output section, which delivers the energy from the power supply to the load (speakers).

#### Devices

Amplifiers utilize various active electrical devices which have different sonic characteristics. A transistor is a semiconductor (solid-state) device. A transistor with a bipolar junction is called a BJT (bipolar junction transistor) or simply a bipolar device. A field-effect transistor is called an FET (field-effect transistor). A MOSFET (metallic oxide substrate field-effect transistor) is a type of field-effect transistor often used as an output device. A vacuum tube is a device where controlled conduction passes through a vacuum.



The British call tubes valves, which provides an excellent description of their function. Tube elements are enclosed in a glass bottle like a light

bulb and the air is sucked out to provide a clear path for electron flow.

#### Output Device Bias

Most solid-state amplifiers have complementary, push-pull output devices, which are biased to operate in Class AB. Push-pull means there are two halves of the circuit containing devices optimized to handle positive-going and negative-going signals, respectively. Class AB means that each device conducts for more than half of the alternating waveform.

One-half of the push-pull circuit conducts the signal when the waveform goes negative (below ground or neutral) and the other half conducts the signal when it goes positive (above ground or neutral). The negative circuit hands off the signal as it starts to go positive and vice versa. Both devices conduct during the transition.

Two kinds of distortion are generated during this transition. Switching distortion occurs when a transistor becomes nonlinear as it turns off, and crossover distortion occurs during the transfer of conduction from one device to another, non-identical

device. Both types of distortion can be eliminated by Class A operation.

Push-pull devices never turn off when biased to Class A, but this wastes lots of energy because current that is not delivered to the load must be dissipated as heat. Real Class A amplifiers are very rare.

Imagine a very large device that delivers very low power and gets very hot and you'll understand why amplifiers that are advertised as Class A seldom have true Class A bias. (Think of a 25-watt amplifier nearly the size of a small refrigerator that produces more heat than your fireplace.)

Some designs have variable bias circuits that try to anticipate the signal level (i.e. Krell). Bias is turned down when the amplifiers idle to minimize heat.

The Sunfire "tracking downconverter" amplifiers, created by Bob Carver, utilize a Class D amplifier to create voltage rails for a conventional signal amplifier. Both amplifiers follow the input signal and the rails for the main amplifier are maintained at a level that is a few volts higher than required to produce the output signal.

Class AB bias allows the amplifier to operate in Class A at lower signal levels, which is what it's doing most of the time when reproducing music. This is the compromise that most manufacturers choose in order to provide both practical efficiency and good sound.

### Digital Amplifiers?

Almost all audio amplifiers work entirely in the analog domain. Digital circuits can be utilized in switching power supplies or switching amplifiers but the signal is not converted to digital. The Wadia Power DACs are different but not commercially available at this time.

A switching power supply creates alternating current that reverses direction at a higher rate than the AC that comes out of the wall socket. Higher frequency alternation requires a smaller power transformer and less storage capacitance but switching noise can be a problem and most amplifiers with switching power supplies are bandwidth-limited by aggressive low-pass filtering.

A Class D amplifier uses the input signal to modulate the width of the switching pulses (PWM, or pulse width modulation). The switching pulses, which occur at very high frequency, are then filtered out leaving only an enlarged replica of the original signal. Class D amplifiers are inherently low-pass filtered to remove the switching signal. The input and output signals are analog.

### Negative Feedback

Most amplifiers are made stable by a negative feedback loop where some of the amplifier output signal is applied to the input in reverse phase. If all the amplifier circuits are included in this loop it's called global feedback. If the loop encloses only one or two amplifier stages it's called local feedback.

A modest amount of negative feedback can regulate gain, reduce distortion, increase stability and raise the damping factor. Excessive negative feedback degrades time domain performance and produces transient intermodulation distortion.

So-called zero-feedback amplifiers still incorporate local degeneration but don't have a conventional feedback loop.

Conventional amplifiers and zero-feedback amplifiers sound different and we'll comment on that later. [APJ](#)

## AMPLIFIER POWER by Richard Hardesty

*To deliver real power to the load (loudspeakers) an amplifier must have a power supply that can generate and store sufficient energy, an output stage that can conduct this energy to the load under varying conditions, and enough heat sink area to dissipate the heat generated in the process. You can judge the potential for a solid-state amplifier to deliver real power by studying the specifications. This will also provide a rough gauge of the quality of construction.*

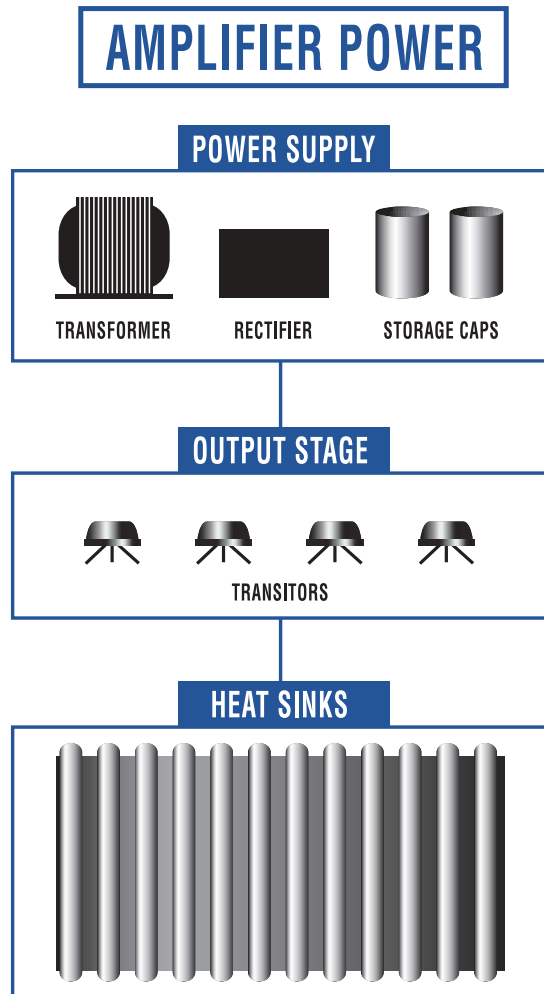
### Power Supply

A linear power supply has a transformer that sets the working voltages and creates the main voltage rails in a solid-state amp and the B+ (high) voltage in a tube amp. Transformers work on alternating current, which must be rectified (converted to DC) by a set of diodes arranged in a rectifier "bridge." The main rail voltage has a positive and negative DC value in a complemen-



tary, push-pull solid-state amp. A solid-state amplifier might have rails of +30 volts and -30 volts, for instance.

The rail voltage sets the limits for power. The output signal swings between these DC rails, as modulated by the input signal. The voltage rails are filtered by storage capacitors. These



capacitors smooth any remaining AC ripples and store energy for quick release during the times when the AC voltage from the transformer is minimal.

Transformer capacity is specified in volt-amperes. The product of voltage and current is power, which is measured in watts (see **Journal #10**). A stereo amplifier rated at 200 watts per channel would need a transformer that could deliver 400VA.

A 5-channel Theta Dreadnaught amplifier, for example, is rated at 200 watts per channel into 8 ohms with 5 channels driven (1,000 watts total and probably double that into 4 ohms.). It has

a 2.2kVA (2,200 volt/ampere) transformer.

Capacitance is measured in microfarads ( $\mu\text{f}$ ). More is generally better. Each channel of the Theta Dreadnaught amplifier has 40,000 $\mu\text{f}$  of capacitance. (I'm using the Dreadnaught as an example because I have a specification sheet handy.)

You can't directly compare the capacitance in a tube amp to the capacitance in a solid-state amp because of the substantial difference in operating voltage. Capacitance should be converted to joules when comparing actual energy storage capability.

A "switching" power supply works much like a linear supply but the alternating current switches back and forth at a higher rate. The AC is created by the power supply and doesn't come right out of the wall, which has a fixed rate of alternation (60Hz in the USA).

When current alternates at a higher rate, the transformer and storage capacitors can be much smaller. Noise may be created by the high-speed switching and must be filtered out so that it doesn't affect the output signal.

### Output Stage

The output devices must be capable of conducting the available current to the load under varying conditions. In solid-state amplifiers this is commonly done by using multiple devices in parallel. Paralleling the devices also reduces internal impedance and raises the damping factor, which is a ratio of external-to-internal impedance. Amplifier damping helps to control speakers at low frequencies.

More devices make an amplifier more robust and capable of driving low impedances but some will argue that an amplifier with fewer devices sounds better. Each amplifier module (channel) in the Theta Dreadnaught has 16 bipolar output devices with a total rated capacity of 256 amperes/3,200 watts.

Tube amplifiers work a little differently because tubes operate at high voltages and don't mate well with modern loudspeakers which have low impedance and require high current. Most tube amplifiers are transformer-coupled to the loudspeaker load.

### Heat Sinks

When current is conducted to the load, heat is created. This heat must be dissipated by heat sinks, or fans, or both. Most

solid-state high-end amplifiers don't have fans, which generate noise that can be audible in a quiet living room. Heat sink area is a gauge of construction quality.

An amplifier with insufficient heat sink area may overheat and shut down on the test bench or during high demand as might be encountered during a home theater presentation of an action movie.

### Cost

The power transformer and the heat sinks are among the most expensive components in an amplifier. Storage capacitors and output devices are expensive and consume space. Cheaper amplifiers can be produced by using parts of lower quality and/or less of them. This may or may not make much sonic difference.

### Examples

A Los Angeles-based amplifier manufacturer makes a five-channel amplifier that is sold direct on the Internet by a "renewed" company. The same manufacturer also makes a similar model that is sold only through their authorized dealers and costs somewhat more. Both of these amplifiers have similar circuit designs and Internet scuttlebutt would lead some to believe that they are the same product.

A close investigation of the specifications will reveal that the "name brand" amplifier has a transformer with a higher rated output, more capacitance and more output devices. The name brand amplifier has significantly more heat sink area but the same power rating. This shows how one product can be offered for a lower price—but does it mean the two amplifiers will sound different? That depends.

The lower priced amplifier will perform adequately into a simple 8-ohm speaker load when there is little demand for power from the other channels. The differences between the two products may become apparent under more demanding conditions.

If the speaker impedance drops to low levels, particularly at low frequencies, or if all five channels are required to deliver high output at once, the cheaper amplifier may overheat and shut off or the transformer voltage may sag reducing output and compressing dynamic range. Will you hear this? That depends on your system and your ears.

In my system the name brand amplifier was noticeably more powerful and dynamic when used for its intended purpose, home theater. When used for critical music listening in stereo, I could discern little difference in the midrange but the bass from the name brand amplifier had more impact and better control. [APJ](#)

## AMPLIFIER SOUND

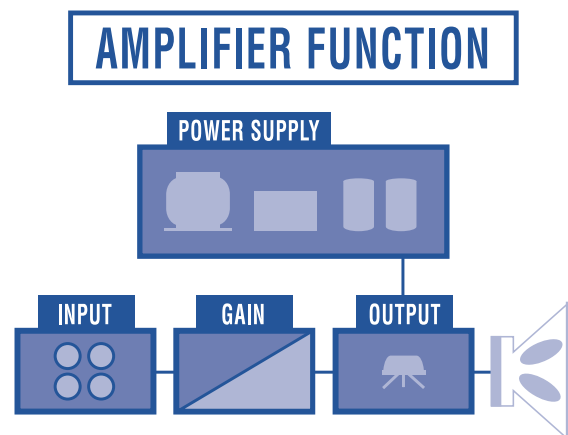
by Richard Hardesty

*A discussion of amplifier sound can be simplified by examining the functional parts of the amplifier separately. In real amplifiers these parts are interdependent and work together in unity but in order to offer opinions about how each amplifier section affects the sound we'll consider them one at a time.*

An audio amplifier has a power supply to store and supply energy to the load (speakers) and sections that enable the flow of that energy. Besides the power supply, the primary functions of the amplifier facilitate input, gain and output.

### Power Supply

The amplifier power supply is what makes the energy that creates the sound you hear from your speakers. The power supply creates and stores energy and some of it is allowed to flow to the speakers to replicate the sounds represented by the input



signal. The speakers don't play the input signal; they play a replica that is created in the amplifier power supply. Obviously the amplifier power supply is a vitally important factor in the sound you hear.

An amplifier power supply consists of a power transformer that establishes working voltages, a rectifier that converts the alter-

nating current from the wall socket into the direct current utilized within the amplifier, and storage capacitors that smooth the DC voltages and release energy on demand.

An amplifier with a bigger power supply (a larger transformer and more capacitance) will tend to sound more powerful and provide more control over the speakers, especially at bass frequencies, but other factors also come into play like the type of output device used and the amount of negative feedback employed.

### Other Amplifier Sections

In addition to the power supply an amplifier has three basic sections: input, gain and output. Different devices may be used in these amplifier sections. The types of devices used can affect the sound you hear.



The input section works with the smallest signals and any errors will be magnified along with the signal when gain is applied. Gain is in effect an enlarged copy of the input signal. Errors and noise will be enlarged along with the signal. The output stage delivers high voltage and current to the load (speakers). Any omissions or additions will be heard directly from the speakers.

The output section is like a valve that allows some of the energy to flow from the power supply to the load (speakers). This energy flow should be an identical copy of the input signal. The largest signals (voltage and current) are handled by the output stage.

### Devices Used in Amplifiers

Amplifiers are assembled from bipolar transistors, field-effect transistors and vacuum tubes and virtually every combination of these devices has been tried. All products with one type of device don't necessarily sound the same but I've listened to hundreds of amplifiers and come to some conclusions about

the sound of certain devices used in certain amplifier sections. I'll share these with you and you can listen and decide if you agree. Knowing my biases will also help you to understand my reviews even if you come to different conclusions.

I don't like MOSFET output devices. This is based on my listening tastes and the types of speakers I prefer. I listen to a wide range of music and demand deep and well-defined bass from my audio system. I like speakers with tight bass control that don't require much amplifier damping and I require time- and phase-accuracy. I would choose an amplifier with superior imaging capability over one with greater bass control because I have speakers which can fully exploit a more dimensional image and don't benefit much from amplifier damping.

Those with planars or mini-speakers may prefer the slightly fuller bass they are likely to hear from MOSFET output stages. Those who listen exclusively to orchestral music may prefer to sacrifice some of what I perceive to be the slightly more defined sound of bipolar transistors in exchange for some of what I perceive to be the slightly smoother sound of field-effect devices.

Tubes have a slightly different sonic character than transistors. Tubes tend to provide a slightly richer harmonic picture of instruments in the midrange with a slight sacrifice in definition and control at the frequency extremes. Twenty years ago this contrast was more pronounced. Modern transistor amplifiers are far more musical than they used to be and the performance of modern tube amplifiers is less compromised. See the product reviews in this **Journal** for detailed descriptions of, and direct comparisons between, some of the best amplifiers available today.

### Bipolar Transistors

Bipolar transistors cost the least and provide the lowest internal impedance. Amplifiers with bipolar output devices tend to have the tightest bass response with the best control of the speakers. A bipolar output stage can have the lowest output impedance and provide the highest damping factor.

Bipolars can sound slightly more mechanical than FETs when used in other amplifier sections but be wary of drawing conclusions about amplifier sound solely by comparing the types of devices used. Let me offer some examples.

Levinson has made some excellent amplifiers exclusively from bipolar transistors. The Ayre V-5x reviewed in this issue has bipolar drivers while the Theta Dreadnaught uses MOSFETs. Both the Ayre and Theta amplifiers have bipolar output devices.

Both the Dreadnaught and the Halo JC 1s have JFET input devices, MOSFET drivers and bipolar output devices. These amplifiers sound completely different. The Halos have 29dB of negative feedback and the Theta amplifiers have none.

The Halos have tighter bass with greater impact and more sharply defined edges around the sound of individual instruments with good lateral imaging. The Dreadnaught presents an image with much greater depth and dimensionality and has, in my opinion, a more natural and musical sonic character.

### Field-effect Transistors

FETs tend to sound slightly smoother and less mechanical when used for input or gain but have a deleterious effect, in my opinion, when utilized as output devices. Some of my favorite amplifiers use FETs in the input and gain sections but amps with MOSFET outputs tend to have soft, full bass and lower resolution in the midrange and at the top. I wouldn't go so far as to use the words "haze" or "glare" but there is something about these devices that I don't like when they're used for output.

Many MOSFET output devices can be used in parallel to get the impedance down and improve bass control slightly but these amplifiers have never been satisfying to me. Listen to a B&K amplifier or one made by ADA to hear what I mean. MOSFET amps from Perreux and Adcom are inoffensive but not very good, in my opinion.

### Vacuum Tubes

Tubes are linear voltage amplifiers but aren't well suited to deliver high current into low impedances. Because of this, most



practical tube amplifiers are transformer-coupled.

Tube amplifiers traditionally have used less negative feedback and been admired for delivering superior, more three-dimensional imaging and purer, more natural harmonic richness. Zero feedback solid-state amplifiers have changed this preconception somewhat.

Audiophiles have always dreamed of a practical tube amplifier with no output transformer. OTL (output transformerless) tube amps are available and sell for slightly less than a king's ransom. They usually have limited power and can be dangerous when failure occurs—which is not uncommon. The practical tube amplifiers most of us will encounter are transformer-coupled to the speakers and the need for an output transformer creates another set of compromises.

### Output Transformers

Tubes are comfortable with high voltage and high impedance. Speakers have relatively low impedance and require high current. Because of this almost all tube amplifiers are transformer-coupled to the speakers. The science of transformer construction is very

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***“To deliver high power at low frequencies a transformer will have to be quite large.”***

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complete yet making good-sounding transformers is still an art. No matter how good it is a transformer will still exhibit nonlinearities outside its useful bandwidth due to hysteresis.

To deliver high power at low frequencies a transformer will have to be quite large. A big chunk of iron will be required to make this big transformer work. More core material tends to make a transformer slower, and the output at high frequencies may be reduced.

Hysteresis is the tendency of a substance to resist changes in magnetization. The function of a transformer relies on changing magnetic fields, and resistance to change makes the transformer act like a kind of flywheel. The output signal won't want to start and stop as quickly as it should and may lag slightly behind the input signal. Resistance is also a problem. The out-



put impedance of a tube amplifier may be 1.5 ohms as compared to a solid-state unit that may have impedance on the order of a fraction of an ohm.

A transformer-coupled tube amplifier can't provide the damping and control of a direct-coupled solid-state amplifier and it can't provide the bandwidth and "air" either. You'll have to decide if there is sufficient advantage in midrange purity to make this trade-off worthwhile to you.

On the positive side, an output transformer will isolate the amplifier from the load making it less sensitive to changes in speaker impedance and reactance. A tube amplifier is likely to drive a difficult speaker load with ease and is unlikely to damage the speakers should a failure occur.

### Negative Feedback

A tube amplifier may have 10-12dB of negative feedback. A conventional solid-state amplifier can have 30dB or more. Negative feedback provides many benefits but amplifiers with no global negative feedback sound different. I prefer this sound but those who choose speakers with wide impedance swings and/or those with vented woofers or underdamped bass may find amplifiers with moderate feedback better suited to their systems.

I wouldn't even attempt to offer a technical discussion of the arguments for and against negative feedback but I'll be happy to share my observations and opinions because that's what we do here.

Excessive negative feedback tends to make an amplifier sound bright and hard. The Nakamichi amplifiers from the late 1970s provide a good example. Their test bench distortion measurements included three or four leading zeros and they sounded simply terrible. Imagine .0001% THD and sound that could heat-seal plastic bags at 100 paces.

Reducing negative feedback to conservative levels allows an amplifier to retain some of the tight bass and good lateral image focus associated with negative feedback while improving midrange smoothness. The Levinson and Proceed amplifiers present good examples of this sound and so do the Halos reviewed in this **Journal**. Tight bass with lots of "slam," great lateral focus and excellent detail resolution are characteristics of this group of amplifiers. The regular Parasound amplifiers

can provide this type of sound along with good construction quality and excellent value.

Zero feedback designs tend to exhibit slightly softer bass with reduced impact, but seem to have more "musicality" and can provide holographic imaging with layers of depth seldom heard from solid-state amplifiers. The Ayre and Theta amplifiers exemplify the positive attributes of this group. No tube amplifier I've heard can deliver an image with more dimensionality than the Ayre V-5x or Theta Citadels. [APJ](#)

## *an interview with...* **David Reich** by Richard Hardesty



*Dave, when we first met many years ago you were extolling the virtues of the Classé amplifier that you had carried into my store. Since then you've been associated with some of the most respected companies in audio—Classé, McCormack and*

*Theta—and you've been responsible for some of the best solid-state amplifiers I've heard.*

*You could have been designing Mars excursion vehicles or less-interesting electrical devices but you chose to create fine audio components instead. What got you started in this industry?*

First and foremost, my love of music. Secondly, the technology to reproduce it. I'll never forget the first time I heard stereo. As a young teenager, I was not aware that my family's two-speaker record player was capable of it, so my older brother and I had continually bought mono LPs. When we brought home Jimi Hendrix's *Are You Experienced* we realized the jacket said it was a stereo LP. (Richard, you may have to explain the software nomenclature to younger readers.) The store didn't have it in mono, so we begrudgingly kept it. Upon listening to it, with my head between the two speakers, I experienced "sound placed in space" and was absolutely amazed. I was astounded

at the possibility of instruments and voices being purposely placed across a soundstage. I had to know more about how this was done!

I was further indoctrinated by building venerable DynaKits and obtaining my first real system. A few years later, while I was visiting the same brother who was attending S.U.N.Y. in Buffalo, NY, we came upon Transcendental Audio, a true high-end store that professed the likes of Decca cartridges on manual turntables, tube electronics, and electrostatic loudspeakers. It was an epiphany. Another enriching experience was attending the Recording Institute at the Eastman School of Music in Rochester, NY. There I had the opportunity to learn electronic theory from the likes of Walt Jung (author of the classic IC Op Amp Cookbook), and rub shoulders with top recording engineers while we learned the ropes on state-of-the-art recording consoles.

Back in Montreal, I found work at a high-end store that sold Dayton-Wright electronics and electrostatic speakers. They were rather, uh, shall we say, temperamental, and I was sent to the Dayton-Wright factory in Toronto for a week to learn how to service them. And that, Richard, was the turning point for me. When I walked through the door of that plant, it may as well have been a time portal. I was transported into a world of music, technology, and fascinating people that would propel me into the industry we call high-end audio. So I really have to thank Michael Wright for giving me the opportunity, though I didn't start amplifier research until about four years later. Dayton-Wright had been sold and within two years, regrettably, closed (some may say thankfully—but I beg to differ).

It was actually while working for a musical instrument amp company that I had some time to begin amplifier research. Why amplifiers? you might ask. Well, there really wasn't much out there to power a highly modified stacked pair of Dayton-



Apogee Scintillas

Wrights, with an impedance of about one-quarter of an ohm. And I figured if I could accomplish that, it would sound that much better on conventional speakers. A few years later, was it any wonder why the one-ohm Apogee

Scintillas and the early Classé amps were a match made in heaven? The Scintillas were a piece of cake compared to what I had designed my amps to drive. My research led to a very small start-up company, which was actually the forerunner to Classé. I sold about sixty 25-watt stereo, pure Class A amplifiers to local dealers within Quebec, and some in Toronto. That was around 1979-80. After that, I refined the design and called it DR-2. Classé was formed in 1981 and the DR-2 was its first product.

*Amplifiers really can make or break the sound of an audio system. Why are they so important to the sound we hear?*

Component audio is a funny thing. I don't think anyone would consider buying a car without a motor. Yet that's exactly what we do when buying loudspeakers. We leave the job of supplying the horsepower to the amplifier. It's a difficult task we take for granted now given that, theoretically, the loudspeaker is part of the amplifier circuit. It's taken decades for us to learn how to minimize the changing effects speakers will have on our amplifiers, and with credit to most designers we've pretty much accomplished that.

Now don't go thinking I therefore favor internally-powered speakers. Powering the woofers is fine, but I haven't heard much else I care for. I believe it's best left to those who specialize in it, and it appears most speaker manufacturers agree. Now with the onset of (truly) digital amplifiers, the varying loads are once again presenting problems, but at least we can rely on DSPs to manage part of that problem.

So, to answer your question, the loudspeaker may have the ability to move rapidly, at many frequencies, with wonderful accuracy, but it won't emit a *ppp* note without the amplifier that precedes it. With that come the speed, stops and starts, harmonic structure, nuance, soundstage cues, and anomalies that the amplifier possesses. Start with a bad amplifier and good speakers and I guarantee you will have bad sound. Start with a good amplifier and good speakers and you may have good sound.

*Today's amplifiers utilize vacuum tubes, bipolar or field-effect transistors, and various combinations of these devices. Can you give us your impression of the technical advantages and disadvantages of these components and the sonic differences between them?*

The simplest, and most boring, explanation of these devices is

well known: tubes and FETs are voltage devices; bipolars are current devices. But that's not my answer because, let's face it, you can't have one without the other. Every voltage has current along with it, and vice versa. So what's really going on? I prefer to look at what these devices do in amplifiers.

Tubes are the greatest seducers in audio. They don't generate too much ugly stuff, and when they do add something it's sooo pretty! Who hasn't been carried away by the ethereal effects of a luscious tube preamp or power amp? Alas, for me, it would always end up as a *too much of a good thing* affair. I couldn't ignore the extras, and particularly in power amps, the often-flaccid bottom was not acceptable to me. Looking at the elements of glowing tubes always made me think of mechanical reverb units. I couldn't help but wonder what all the vibrations were adding to the sound! That, combined with the device variability and its declining performance over time, provided too many parameters I couldn't control, so I opted for solid-state devices and challenged myself to make music with them.

Initially I worked exclusively with bipolars. I liked their finite operating parameters, and found that if you manipulated them in heavy enough Class A, you could eliminate their nasty characteristics. Once I got rid of the bright, edgy hardness of a bipolar, a wealth of harmonic structure and holographic information revealed itself. The sound of the early Classé designs was always compared to tubes, yet they were done entirely with bipolars.

Back then, MOSFETs were just coming along and numerous designers jumped over to them. They were technically forgiving so an average design with them yielded reasonably musical results. But in an output stage, for me, they lacked current.

MOSFETs are much better now, but I still use bipolars in the output stage of amplifiers. This stage, after all, is purely for amplification of current. All the voltage amplification has already been done in prior stages, so why not let the bipolars do what they do best! Besides, I am a total current and power hog when it comes to output stages. The possibility of blown output devices leaves a very bad taste in my mouth, so I design these stages very conservatively, with gobs of output current capability. And I think they sound better that way. You can hear an output stage that is working too hard, as opposed to one that's coasting. I'll take the latter. Of course, you do not want more devices than necessary so there are trade-offs that

must be carefully evaluated.

*Theta builds solid-state amplifiers using FETs and bipolar devices. Why do you use one type of transistor in the input section and another type for drivers/gain and yet another type for the output stage?*



The previous answer partially addresses this, particularly for the output stage. We haven't mentioned JFETs. They don't get much attention because they are almost

exclusively small-signal devices; little guys that can't handle too much voltage. But do they sing! Small devices tend to sound superior anyway. I recall a Nelson Pass design: I believe it was a 10-watt amplifier, supposedly built with 100 small signal devices. A sweeter sound was never heard! Their low voltage amplification is incredibly linear, making them ideal for input stages—and preamps, for that matter. And there are tricks, such as cascoding, that allow you to implement them in higher voltage circuits. The MOSFETs we touched on above have earned a solid position in the second stage and driver stage of my amplifiers. Their input impedance, like JFETs, is high so they don't load down preceding stages, and they set up the signal for the output stage beautifully. JFETs, MOSFETs, bipolars. It's a popular configuration in many good amplifiers.

*In your opinion, which sections of an amplifier have the greatest effect on the sound we hear?*

By the sheer fact that any given section of an amplifier can mess up its sound, I am forced to give equal strength to all sections of the product. The power supply, input, driver, and output stages are so dependent upon each other that, while individually addressed, they operate as a whole system. The effects of each section must be evaluated with those that precede and follow it. The only exception is the output stage, the performance of which depends more heavily on the power supply.

*The amplifier power supply is especially important. What makes a good one? If cost didn't have to be considered how could you make a better power supply?*

I presume you are referring to the supply that powers the output stage, and not the low current supply that takes care of the previous stages (that, too, is important). Conventional, unregulated, linear supplies that most commonly power output stages are made up of three basic elements: magnetics, rectification, and filtering—or the transformer, rectifier(s), and capacitors. The variables of a power transformer for an audio product are so complex that, in terms of massaging those variables to achieve great sonic performance, it easily competes with the amplifier itself. And be sure that we are talking about just a power transformer here, not an audio transformer, which may be even harder to design. If it sounds like I'm paying my respects to transformer craftsmen, I am. A great transformer's design goes way beyond its electrical voltage and current requirements. Rectifiers are important also. In Theta's Dreadnaughts, because each channel module has its own capacitor bank, it is also able to have its own bridge rectifier. Power and speed are important here, as are some other less familiar parameters. Now capacitors are lots of fun, and we've seen trends go from giant ones as big as your neighborhood transformer sitting atop a pole, to multitudes of tiny ones, and everything in between. And don't get me started on bypassing. But designers have come full circle on this, I believe, and, in general, multiples of moderately sized caps work well. One of them per output device is even better if you have the space and budget for it. Credit Steve McCormack for that, who was the first to do it.

As for making a better power supply, that's what we did in the Citadel. Power supplies took a giant leap forward when we added "choke-input filters," as discussed by Charlie Hansen in **Audio Perfectionist Journal #10**. The effect is nothing less than synergistic, resulting in power supply lines so clean that



*Krell*

the output stage thinks it's a preamp. But these chokes have to be big enough, or dynamics may be restricted. In Citadel they are almost as large as the power transformer itself.

Beyond input chokes, that leaves only the fully regulated, high current supply, which effectively requires its own output stage as large as the audio stage. Back to the Levinson ML-2, or perhaps some Krells for that, I think. Results have been mixed, some feeling it left the bass overly taut and the sound restricted. In the other direction, there have been cost-effective designs with minimalist supplies, building a "loose" supply with just enough oomph to give a lively and dynamic sound, if not scrutinized too closely.

*Theta's amplifiers have no global feedback but some of your previous designs have used modest amounts of negative feedback. What's your current position on this controversial subject?*

Right now, I have to say I love the way our amps sound without feedback. Feedback is, after all, a case of trying to correct for something that's already happened. There's a freedom from hash and grain without it that just seems to be saying, "Hey, I'm running free and I don't have to double back and cover my tracks." I'm not negating good sounding amplifiers that use some feedback. Hey, I reserve the right to do so in a future design if I see fit. I will even go out on a limb here and say, contrary to popular opinion, I think there are some excellent sounding op amps, and I have employed them successfully in past designs. Perhaps keeping the overall loop within chip size helps. But that said, zero feedback is where I am right now. And Theta's amps are very happy that way.

*Theta makes several amplifier models that share similar circuitry. Can you tell us about how they differ and how these differences affect the sound?*

It might be easier to first discuss their similarities. They all have the following in common:

- 1) True, fully balanced circuitry. What a pleasure this is to work with. Mirrored circuitry that can't be beat for any common mode rejection of noise, distortion, EMI and RFI. It's just so quiet and helps give you a beautifully "black" background from which pure signals can spring. The way we do it, even our single-ended input benefits. With today's digital sources it helps achieve greater dynamic range, too.
- 2) Three-stage circuitry topology, with zero overall feedback. JFETs, MOSFETs, and bipolars are used for the input, driver, and output stages, respectively.



3) Linear, high current power supplies for output stages. Fully regulated, discrete MOSFET circuits for all preceding stages.

I think that covers the main common features. There are some component differences between models. The single-channel module in Enterprise is very similar to that in Dreadnaught, but the loosening of price restraints gave me the opportunity to include items from my wish list that could not go in the multichannel amplifier. The modules in the Dreadnaught II (225W) and Enterprise (300W) both use toroidal transformers. Power is shared by two of them in the Dreadnaught and one in the Enterprise. So they are quite similar, and you could say the Enterprise is a more powerful Dreadnaught. But the latter also benefits from being a monoblock, which brings it closer to our flagship Citadel.

The stereo module for the Dreadnaught (2 x 100W) and each channel of the Intrepid (100W) are similar. While the low frequency limit of all our amplifiers is below 1Hz, they are not DC coupled, and capacitor quality bears sonic significance here. Because of size constraints, these two models use different, more compact capacitors than the other models. The Dreadnaught stereo module must share the same power supply as its higher powered brother, so the power is set by limiting the regulated supply lines on the actual card. The Intrepid has its own unique EI core transformer.



Citadel (400W) stands above all our other models, sonically and literally. I have discussed its power supply above. Many other components have been sonically selected for their specific application. These include custom-made film capacitors, Vishay precision resistors, solid copper buss

bars, Litz/Teflon Cardas wires, and a custom-made output connector. They all combine to give Citadel the status it has been awarded by reviewers and consumers alike. Of course this makes for a successful product, but moreover, as a designer, it provides invaluable feedback as to how well my applied design techniques are tied to the way I hear things.

*Theta Digital built its reputation on unique digital-to-analog converters and surround sound processors. Today the company makes some of the finest analog amplifiers available. What do you see in the future?*



I see both (digital and analog) technologies continuing and merging, which comes from the fact that each technology now has a solid footing.

They no longer are mortal enemies that prefer to exist at the exclusionary expense of the other. I find it fascinating that major semiconductor companies that offer both are extolling the virtues of analog as well as digital right now, because digital has been an easy sell for so long while the virtues of analog were nearly forgotten. Closer to home, Theta is doing research on digital amplifiers now, future products that will be welcomed for their small size, great efficiency, and good sonics.

It is my task, and Theta's mission, to bring a sense of immersion realism to these new technologies, integrating them with the rest of Theta's highly evolved designs. The standard we have is high enough that a lot of the work is in getting the new technology up to the threshold of the old, so that we're actually making improvements instead of slipping backwards by going with the newest way of doing things. Theta's constant offering of an upgrade path has to stay an upgrade path, after all, not a sideways or a downward one! This keeps me honest—and it certainly keeps me busy.

*Thanks for an informative discussion of amplifiers, Dave. I'm sure our readers will learn a lot, as I have. [ARJ](#)*

## MY REFERENCE SYSTEM by Richard Hardesty



*Things continually evolve and my reference system has undergone substantial changes. I acquired a VTL 7.5 Reference line preamplifier and upgraded to Vandersteen 5A speakers. These are connected with battery-biased Audio Quest Cheetah interconnect cables and Kilimanjaro speaker cables. I have upgraded to a Wadia 861se CD player and had my Sony 9000 SACD player modified by Vacuum State Electronics. Everything is placed on "Racks of Silence" from Solid Tech of Sweden. Reviews of the CD player and racks will appear in the next **Journal**. You can read about the Sony modification below.*

*Last year I demonstrated reference-quality sound from modestly priced components. At this year's seminars we'll pull out a few stops and demonstrate what is possible in a regular living room.*

## *modified...* SONY DVP-S9000ES by Richard Hardesty

*Every so often the Sony people make amazing products just to demonstrate their manufacturing capabilities. Sometimes they sell these exceptional components for a surprisingly low retail price that places them atop the competitive heap in the mass market. While these products may not quite provide state-of-the-art audio performance they are always mechanically superb and are a bargain for you and me.*

Three notable components fall into this category: 1) the SCD-1 SACD player, a flagship audio machine with battleship-like construction quality exceeding that of high-end products costing far

more; 2) the 2-channel 777ES SACD player, which, while available, provided nearly equivalent construction quality for about half the money; and 3) the DVP-S9000ES DVD/SACD player, which was released as a flagship video product but delivered SACD audio performance on a par with the more costly audio-only components. I have lived with and reviewed all three products and I purchased the 9000.

I was pleased by its SACD performance in stock trim but intrigued by what might be possible by upgrading the rather mundane quality of the components in the signal path. Allen Wright of Vacuum State Electronics, Inc. (<http://www.vacuumstate.com>), was equally curious and set about developing a comprehensive modification for the Sony 9000 and similar SACD players.

I had a VSE modification kit, designed by Allen Wright, installed by Warren Gregoire and Associates in Central California



(<http://www.warregregoire.com>) and that mod is the subject of this review.

### DVP-S9000ES DVD/SACD Player

The DVP-S9000ES video player was introduced at a list price of less than \$1,500, which was soon dropped to just \$1,299. I bought one new-in-the-box from an authorized dealer for \$900! This is a pretty good price for a state-of-the-art DVD player with progressive scan video output but I got it to use as an SACD audio player.

I chose the 9000 after listening to the SCD-1 and the 777ES and the newer multichannel 777 player. The 9000ES proved to be comparable in audio performance for a lot less money. To be fair, the more costly machines had slightly fuller bass for a richer and ever so slightly more balanced sound but I found that I could make up for most of the difference by placing the 9000 on a Townshend Seismic Sink isolation platform. Atop the isolation platform the stock Sony 9000 was an outstanding DVD player, a so-so CD player, and a very good SACD

player with bass performance that was just slightly less satisfying than the more costly Sony players. It had single-ended outputs only and a low-pass filter fixed at 50kHz for SACD.

I wanted balanced operation to match the rest of my completely balanced system and I was disappointed by the fixed 50kHz filter in the 9000. The flagship SCD-1 had balanced outputs but



sounded better when the single-ended outputs were employed instead (something inside probably wasn't really balanced). The SCD-1 had a switchable low-pass filter and sounded better set to 100kHz. The 9000 had neither balanced outputs nor a switchable filter but lots of potential.

### **Pretty Good But if Only...**

Sony's flagship products have all been pretty good performers but have left audiophiles shaking their heads and muttering, "if only..." Sony's mechanical designs are tours de force but apparently nobody there actually sits down and listens to the results. This has led to the creation of a cottage industry that specializes in modifying Sony products in order to satisfy the needs of a more demanding audiophile clientele.

Most of these modifiers simply replace the passive electrical parts, like capacitors, with higher quality alternatives and add a precision clock because Sony is known for using the cheapest available electronic components. These component substitutions can lead to audible improvements but Vacuum State Electronics is different. Their goal was to fully exploit the potential of the high resolution DSD format, not simply to provide minor refinements to the sound of the stock Sony players.

The mechanical design of the Sony seemed to be exceptional but Allen Wright of VSE observed that he could substitute a

low-jitter precision clock module for the cheap crystal used by Sony, and provide a separate current source and shunt regulator for this module. He found that he could bypass the capacitors on the Sony digital circuits with a group of exotic devices and improve the sound—but he wanted more.

In addition to inexpensive passive components Sony likes to employ lots of integrated circuits with generous amounts of negative feedback. Wright carefully examined the audio signal path in the Sony player to find the first place where he could tap the digital audio signal and improve the sound during the reconstruction of the analog waveform.

### **Sony SACD Player Modifications**

Sony makes some of the best SACD and DVD players available in the mass market. The DVP-S9000ES represents amazing value for money. It's beautiful with excellent ergonomics. It's heavy with high quality mechanical construction. And it sounds pretty good.

As a CD player the stock Sony provides inoffensive sound that is slightly soft and lacking in detail. The image is OK with pretty good lateral focus but little depth. As an SACD player the Sony



is quite good. I have directly compared it to the Classé Omega and the dCS players and the Sony was not embarrassed. In fact I preferred it to the Classé, which costs about \$12K. The Sony simply dumps the Pioneer and Marantz players. In my opinion it's better in every way.

The Sony sounded good despite the fact that there are four integrated circuits with generous amounts of negative feedback in the signal path of each channel! These op amps are completely eliminated by the VSE modification and replaced by a



single-stage filter/buffer amplifier with no negative feedback.

That's right. In addition to the precision clock mechanism and bypass capacitors, the VSE mod includes an all-discrete component, single-stage filter/buffer amplifier. In my case there are two of these because my modification is completely balanced and the circuitry is duplicated. This amplifier(s) replaces the multiple op amps in the signal path of the stock Sony player. Some gain is lost and the output is reduced slightly but this won't be a problem for those with an active preamplifier.

The amplifier module is powered by a separate state-of-the-art, analog power supply with its own toroidal transformer, Schottky diodes and VSE SuperReg current source regulator. Balanced



output connectors are installed on the back panel for the modified signal and because the signal for the upgrade module is taken from the Sony board before the DAC, the original unmodified signal is still available from the stock single-ended connectors.

### How Does it Sound?

You can probably buy a Sony 9000 and have a single-ended modification installed for less than \$2,000 total. (The balanced mod costs about \$1,500 and uses two filter/buffer modules adding about \$500.) I wish I could tell you that you'll end up with a state-of-the-art CD player that will rival the performance of the \$10K Wadia 861se and an SACD player that will outperform the \$20K dCS Verdi and Delius combination but I can't.

I can tell you that what you'll get will blow the doors off of anything anywhere near this price and will beat most competitors at several times the cost of the modified Sony player. Here's a more detailed description.

### CD Sound

As a CD player the modified Sony 9000 provides far more detail than the stock player and the image is substantially improved with greater depth resolution. This change is likely to be startling at first because it's not subtle. The stock player was a little

light in the bass and the added detail provided by the modification accentuates this imbalance so you may have to experiment with supports and isolation devices to flesh out the bottom end. With some attention to setup the modified Sony competes favorably with high-end CD players up to the \$6,000 category.

When compared directly to my reference Wadia 861se the performance of the Sony falls slightly short, providing a more mechanical sound that lacks the three-dimensionality and palpability of the \$10K Wadia. That's nothing to be embarrassed about. The modified Sony 9000 can perform well as a CD source in all but the highest resolution systems.

### SACD Sound

The SACD performance of the stock player was more than respectable. The modified player has vastly more detail and significantly higher resolution. The Sony can't equal the relaxed and virtually distortionless sound of the dCS Verdi/Delius when playing SACDs but the dCS stack costs nearly \$20K! The modified Sony 9000 compares favorably with anything else I've heard.

The dCS combination offers sound that can sometimes rival vinyl. The Sony can't. It always sounds slightly less natural and musically involving than my turntable, which, admittedly, costs a lot more.

### High Resolution Digital Sound

The 9000 is a DVD player and can play 96/24 high resolution digital recordings (not DVD-Audio discs), which the others can't. There aren't many of these discs available. They sound excellent and the modified player handles them with aplomb.

### DVD Performance

DVD performance appears to be unchanged but I didn't fully evaluate the video capability of the player for this review because the **Journal** is essentially an audio publication. The player still provides the ergonomic excellence of the original and the convenience of a full-function remote control that works the way it always did.

### Conclusion

The VSE-modified Sony 9000 player isn't the best source I've heard, but it's damn good and an exceptional value for money. Warren Gregoire and Associates are so convinced you'll like it that they offer to remove the mod and refund your money if you don't. You can find more information on their web site. [API](#)



# AMP SURVEY

by Shane Buettner



*The reviews and observations presented here combine impressions of products that Dick and I reviewed over the years for Widescreen Review (and in my case, other publications) and completely new experiences with some of the finest*

*amplifiers currently available. While many of the amps reviewed in previous issues of the **Audio Perfectionist Journal** were reviewed by me or Dick exclusively, all the featured amps in this issue were reviewed by me and listened to by Dick up at my place in northern California over a visit that lasted a few days. We feel the additional perspective of two listeners is immensely valuable.*

Please understand that the current composition of my system—particularly the presence of Vandersteen Model 5A loudspeakers—has an impact on power amplifier reviews.

My other amplification components include the VTL 7.5 Reference preamp, Aesthetix Rhea phono stage, Linn LP 12 turntable (Akiva/Ekos/Lingo/Trampolin-equipped), and the Musical Fidelity Tri-Vista CD/SACD player.

A future issue of the **Journal** is likely to include a follow-up on the VTL 7.5, which I purchased after reviewing all the preamps featured in **APJ** #10. The production model I bought sounds even better than the review unit I heard, which had been around the block a bit. It's a divine reviewing tool and a component that has increased my listening enjoyment so immensely that I have more to say about it than was said in **APJ** #10!

On the Vandersteen Model 5As, regular readers will know I bought the review units that I listened to and wrote about in *The Absolute Sound*. My only trepidation was what this might mean when reviewing power amplifiers as the 5As have built-in powered subs that decrease the load and strain placed on the amplifier.

The signal is high-pass filtered at 100Hz before the amplifier in this system. Dick and I spoke about this before I made the purchasing decision and we decided together that this speaker, aside from being the finest we've heard, is the ultimate expression of the **Audio Perfectionist** philosophy that Dick has cultivated in decades of experience and that I've adopted in recent years as I've found its principles to lead to an ideal of musical satisfaction that I hadn't been able to realize before.

The chief principles I'm speaking of are Dick's long-stated practice of employing powered subwoofers with passive high-pass filters.

Following Dick's guidelines in this respect allows you to use amplifiers best suited for their particular tasks. You can find the amplifier that is the most musically satisfying with respect to midrange detail, clarity, and imaging, for example, while not having to be overly concerned about how that amp will handle the low end of the speaker.

The best amplifiers we've heard for bass authority—the Levinson 33H or the CAL digital switching amps—are inferior in

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***“We intend our reviews to be a way to narrow down the list of contenders...”***

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all other respects to the Theta Dreadnaught and Ayre V-5x. Why settle for compromised performance in one way or another when you can have it all by adding a passive high-pass filter and a powered sub?

The chief drawback to this approach in the review arena, since not all **APJ** readers use a similar system, is that relieving the amplifier of the deep bass duties may not tell some owners of full-range loudspeakers exactly how the amp will perform in their systems. One thing I learned using the 5As during the initial *TAS* review is that, while a degree of strain is lifted from the amplifier, the 5As still give me a lot of information about the quality and articulation of the amplifier's bass output. I can distinctly hear the bass characteristics of the amp under review in stark relief; I just can't be 100% sure if the amp would be showing more strain under full-range use. That's something for you to investigate.

Dick and I agree that's a key point too. We intend our reviews to be more of a way to narrow down the list of contenders than a simple one-stop shopping guide. They're based on our opinions and biases and should be a beginning rather than an end unto themselves. We're able to tell you what we like, and why, and hopefully that will help you narrow down the field and find the product you like. As Dick is fond of saying, while he can tell you what's worked for him, he's no more qualified to pick your hi-fi for you than to choose your spouse!

A final aspect of the reviews worth addressing is that the values used for setting the Vandersteen high-pass filters correctly are based on the amplifier's specified input impedance. If that value is correct the -3dB point should be at 100Hz or as close to that number as possible to achieve the best blend, and in this case to make sure that the blend on one amp is similar enough to the blend on the other that you're hearing the differences between the amps and not the setup.

To ensure that this critical parameter would be set correctly we tested each amp's -3dB point with a signal generator and a voltage meter with the filters set to the specified input impedance value. In all cases, except for the Nagra VPAs, the -3dB point was exactly 100Hz, or off by no more than 10 cycles. On those pesky Nagras we used the signal generator and voltmeter to find the proper setting for the high-pass filter to achieve the desired -3dB at 100Hz. [APJ](#)

## VT100 MKIII

audio research by Shane Buettner

*Doing a power amplifier survey that includes tube amps but doesn't include Audio Research would be like doing a soft drink survey that leaves out Coca-Cola®. Minnesota-based ARC obviously has been a fixture in the industry for over 30 years. While competition among tube manufacturers has certainly increased to the point that it's no longer ARC and then everyone else, ARC is still manufacturing world-beating products and introducing significant new ones. In fact, the best sound I heard at this year's CES and T.H.E. shows was in the ARC room with an ARC front end featuring a hot new pair of tube monoblocks (the 200 watts per channel VM220s) driving Vandersteen Model 5As.*

For this issue of the **Journal**, ARC spirited along the VT100 MKIII, a fully balanced 100 watts per channel stereo tube amp with a retail price of \$6,495. The VT100 has been in ARC's line



since 1996. Upgrading to MKIII status involves replacing both main circuit boards, swapping the 6922s with the Super Tubes, changing the rear panel to accommodate the balanced/single-ended switch and 12V trigger, and adding the daughter board that supports these changes. Upgrading from MKII status to MKIII carries a retail price tag of \$1,895, while going from an original VT100 to the MKIII is \$2,695. Once upgraded ARC provides an additional year of warranty (90 days on the tubes).

### Outside

Classic ARC fit & finish. Our review sample was finished in sharp black with a single power button and two large handles on the monolithic front panel. The top and bottom are vented to provide good airflow. The rear panel features single-ended and balanced inputs, and a toggle switch to choose between the two. This is a change—previous models required a shorting link for the balanced inputs if single-ended operation was desired. Four- and 8-ohm output taps are provided on very rugged five-way binding posts. The power cord is removable and a 12V trigger is also provided.

### Inside

The VT100 MKIII features a dual-mono circuit design said by ARC to be derived from the VTM200. It's a hybrid design that uses JFETs for gain in the input stage, with each channel employing a 6H30 "Super Tube" in the driver stage that's cap-coupled to another 6H30 "follower" (previous iterations of the VT100 used 6922s instead of 6H30s).

ARC claims this “driver-follower” topology delivers higher current capability, more headroom, and prolonged life span for the four 6550Cs in the output stage of each channel. Not a bad idea since the 6550Cs are big tubes that will typically need to be replaced more often. Four bias adjustments are available internally (previous iterations had only two) for more precise adjustment of the output tubes. ARC told me not to fiddle with them if the amp sounded fine, which it sure did.

The VT100 MKIII runs hot like all tube amps, and includes an onboard fan. I had the VT100 MKIII about ten feet from the listening position and I could hear the fan noise, albeit faintly, when no music was being played. Once the music starts, even at low volume, the fan noise is gone.

### Performance

This ARC stereo amp made excellent even addictive sound right from the get-go. The first thing I latched onto with this amp was the holographic, three-dimensional imaging. This is one of those amps with a full, rounded and airy dimension that’s utterly convincing. Sound gets out away from the speakers, with a soundstage that’s deep front to back and extends well beyond the speakers at the sides. Trying to quantify what tube amps have that solid-state amps don’t is trickier than it seems. The best description I can offer is that tubes sound less like electronics and more like music. And you’ll know it when you hear it. The ARC amp exhibits those elusive characteristics in spatial and tonal sonic attributes.

The bass of the VT100 MKIII was just a hair light, without the mid-bass warmth and richness I heard from the VTLs and even some of the solid-state amps. This contributed somewhat to the ARC’s lively and detailed midrange, which has a jump factor and immediacy that are quite arresting. Retrieval of low-level detail was right in there with any of the amps we listened to, and the MKIII was in fact superior in this critical regard among the tube amps reviewed here. Subtle things were revealed with clarity: a piano player softly humming the tune he’s playing, a guitar player slapping the body of the instrument. These seemingly small revelations are the kinds of things that take me closer to the music and the performance.

The top end extension of the VT100 MKIII was slightly rolled off compared to the solid-state amps reviewed, but was competitive with both the Nagra and VTL amps, both of which cost

much more. So, while piano fundamentals and cymbal splashes had good clarity and impact, the decay of both instruments wasn’t quite as airy or extended compared to the solid-state amps especially.

Even though its power rating is lower than some of the other amps reviewed here, it is powerful enough to deliver heavy rock tunes and symphonic material without noticeable signs of strain at reasonably high volumes. It’s not as effortless as the 200 watts per channel VTL MB-450, but neither should anyone expect it to be.

For the sake of comparison, switching from the ARC to the outstanding solid-state amps like the Theta or the Ayre, the first things you notice with the solid-state gear are an overall increase in clarity and improved extension and control at the frequency extremes. I perceived what I’d describe as a slight gauze on the ARC’s sound compared to the startling clarity of the excellent solid-state amps reviewed here. This isn’t something you’ll be concerned about unless you do an A/B comparison such as we’ve done here.

### Conclusion

The ARC VT100 MKIII had better midrange resolution than either of the other tube amps we reviewed for this issue, and was competitive with them in every other way—with the added benefit of being priced much lower. The VT100 MKIII has upfront and lively perspective that’s musically inviting and captivating. I recommend it highly without condition as an excellent performer and an outstanding value. **APJ**

*Manufacturer Information*

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*Richard Hardesty comments on...*

## **audio research VT100 MKIII**

*The Audio Research VT100 MKIII proved to be an excellent all-around amplifier. The ARC had slightly lighter bass and presented the music with a more forward perspective than the VTL but seemed to offer superior timing (rhythm and pace). The ARC couldn’t compete with the VTL amplifier’s amazing power and clarity but the ARC amp costs a lot less.*

## Ayre V-5x by Shane Buettner

*I started chasing Ayre's amplifiers almost three years ago, after I'd heard and bought a Theta Dreadnaught power amplifier. Ayre's president and chief designer Charles Hansen had done the basic circuit design for the Dreadnaught and Ayre was coming out with its own multichannel amplifier and I was interested. The first amp I caught up with was the V-6, which was, like the Dreadnaught, a fully balanced, zero feedback design. I reviewed the original V-6 for *The Perfect Vision* and found it to excel in most regards, with my chief criticism being its bass performance, which I found too light for a sonically balanced presentation. Ayre improved on the V-6's performance substantially with the V-6x.*

The amp we're reviewing here is the V-5x, a stereo amp with the same amplifier modules used in the V-6x, that costs just \$4,500.

### Outside Fit & Finish

The V-5x looks familiar. It shares the plain but timelessly handsome look common to virtually all of Ayre's products. The aluminum chassis is available in either silver or black and I'm particularly partial to the latter, which has a deeper, richer look to



my eye. Only a single power button and indicator adorn the front panel and, oddly, when the LED glows green the amp is in standby mode, with blue indicating the unit is powered up. Green doesn't mean "go" here!

Each channel module has its own set of balanced and single-ended inputs and a switch to choose either mode of operation. This amp conforms to the Ayre tradition of staggering the orien-

tation of the speaker terminals—one channel's terminal is toward the bottom of the back panel, the other toward the top, and they're aligned diagonally. This has obvious aesthetic appeal but in practice I'd prefer the more straightforward approach of horizontally oriented speaker terminals at the top of the back panel.

I found myself twisting my speaker cables to get one set going into the top of the terminal and the other in from the bottom and, in both cases, there was additional torque on the cables as they leaned out from the diagonal terminals that I'd prefer not to have. You'll either love the Cardas speaker terminals, as I do, or be driven crazy by them—Dick falls into this camp. A balanced pass-through output is included for each channel also, and two LEDs to indicate blown fuses.

### Under the Hood of the V-5x

Each channel of the V-5x is rated at 150 watts into 8 ohms and 300 watts into 4 ohms. Each solid-state module is a fully balanced symmetrical bridge design that employs no loop feedback anywhere (read the Charles Hansen interview in **Journal 10** for more about his design philosophies and his incisive thoughts on feedback).

The input stage employs JFETs, while the driver and output stages use bipolars. The output stage of each channel uses sixteen bipolar devices to ensure low output impedance. As with all of Ayre's signature products the V-5x uses discrete circuits entirely, with the paths being as short as possible with only a single pair of Cardas wires connecting the output board to the speaker terminals.

Ayre's proprietary "Ayre Conditioner" operates in parallel with the incoming AC using a non-ferrous filter to absorb RF before the transformers and rectifiers and to convert it to heat. As a parallel device, the Ayre Conditioner doesn't have the dynamic limiting issues often exhibited by typical power line conditioners operating in series with the incoming AC. The Ayre V-5x power supply uses a substantial EI core transformer.

### Performance

The Ayre V-5x is simply an awesome amplifier, but let me get one detail out of the way first. Like all of the Ayre amps I've heard, it's light in the bass compared to the other amps reviewed here. I've been using powered subwoofers in my sys-



tem for the last few years so this wasn't an issue for me.

While the zero feedback design probably has a lot to do with this, the Theta amps also use no feedback and they provide a more solid low frequency foundation. Now, let's get to the good stuff.

All sonic attributes of the V-5x are enhanced greatly by what you don't hear with this amp—distortion of any kind or background noise. The V-5x has what I've come to regard as Ayre's house sound: plush, dead quiet background, outstanding image focus and dimensionality, and a highly resolved midrange.

The V-5x is one of the very best amplifiers I've ever heard with regard to focusing musicians in space convincingly. The delineation of spatial cues in the soundstage from front to back, and especially side to side, is as sharply drawn as anything you'll find. The holographic, three-dimensional imaging is outright spooky, with focus ranking way up there with the very best of the best.

My reviews often include a distinction between components that capture the music and those that go beyond allowing the listener to see farther into the recording space. This amp takes you into the recording space and lets you see very deeply into the music. Its low level information was on a par with Theta's Citadel monoblocks. The Ayre isn't quite as refined or powerful as the big Theta, but the fact that such a comparison can be legitimately made speaks incredibly well of the V-5x at \$4,500. And the Theta Dreadnaught, excellent as it is, isn't quite as detailed through the midrange or as quiet as the V-5x. The V-5x has resolution to spare.

In addition to all the things the Ayre V-5x does right in hi-fi terms, musical purity is another hallmark of Ayre's sound that's on display here. The Ayre has a pure and liquid sound that's less hi-fi than is typical of solid-state. Strings, in particular, have a naturally detailed and textured sound that's crisp and sharply defined but still organic and musical. Theta's \$16K per pair Citadel monoblocks are the only solid-state amps I've heard that match, and slightly exceed, the V-5x's combination of liquid musicality and resolving power. At its price point the V-5x is a revelation.

Both Theta's Citadel and Dreadnaught outperform the Ayre in top end extension and openness. But I hasten to add that the V-5x seems better in this regard than my memory of the V-6x. The V-5x seems to have a little more sparkle and a little more



openness with cymbal splashes and piano decay, for example, than the other Ayre amps I've heard, albeit with a little bit more of a visceral sound than I remember. I wish I'd had the V-6x on hand for a direct comparison. In any case, as well as the Ayre amps I've previously experienced have performed, the V-5x is yet another step up.

### Conclusion

The Ayre V-5x is one of the best power amps available at any price. I've never heard anything with more midrange resolution or better image focus. It's quiet and refined, and exceptionally clean, pure and musical. You have to spend a lot more to get slightly better performance. The V-5x is a triumph for Ayre! [APJ](#)

#### Manufacturer Information

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### *Richard Hardesty comments on...* **Ayre V-5x**

*The Ayre V-5x was particularly outstanding in two areas: the presentation was incredibly silent and this amp made some of the most holographically real images I've heard. The Ayre was noticeably lighter in the bass than the others and seemed just slightly closed down at the top compared to the best solid-state competitors. This is a remarkable value for \$4,500 and one of the best amplifiers available regardless of price.*



### JC 1 Monoblocks by Shane Buettner

*Parasound has secured a very solid reputation with me over the years. Every Parasound product I've heard, from the power amplifiers I've personally owned to the new Halo P 3 preamplifier I reviewed for TAS, has been an outstanding performer for the price and a challenge to products costing substantially more.*

*San Francisco-based Parasound has undergone a bit of a face-lift lately splitting their products into two lines: Classic Parasound and the new Halo by Parasound series. Both lines are strong, but the Halo line clearly has star attraction with an ambitious array of new products including solid-state power amplifiers, two digital controllers, and very affordable preamplification components.*

The focus of this review is the Halo JC 1, a 400-watt (8 ohms) monoblock designed by John Curl and his team at CTC Builders and manufactured in Taiwan. I've been excited about this amp since I first saw it at CES a few years back. With Parasound's habit of delivering more sound quality at a given price point than the next manufacturer, I couldn't wait to hear what they could do with a \$6K pair of monoblocks.

#### Outside

I had seen a number of photos of the JC 1 but hadn't seen it in person since that CES a few years ago. Let me tell you that the



photos don't do the fit & finish of this product justice at all. Inside and out you're unlikely to find a more beautiful or ruggedly built product.

Each 64-pound JC 1 comes in a black velvet wrap and exudes the elegance and beauty of a carriage trade product from the get-go. The JC 1 is gorgeous heavy aluminum finished in silver, with massive extruded aluminum heat sinks running along both sides of each amp. In addition to looking good an aluminum

chassis is advantageous because it's nonferrous and resists magnetic anomalies and eddy currents.

The front panel has a power switch that glows blue until engaged, at which time it glows red until the amp is operational, then returns to blue. The "P" logo glows red on power-up, and the lower right corner of the front panel houses a thermal warning LED. On the back panel you can also toggle between manual power-up, auto power-up on detection of an input signal, or power-up on a 12V trigger connection. For the autodetect power-up the sensitivity at which the input signal is detected is also adjustable. There is also a user-adjustable (0-12 seconds) delayed turn-on for sequencing power-up of any number of JC 1 amplifiers.

The back panel has single-ended and balanced inputs with a toggle switch to select the proper mode of operation. The JC 1 is said by Parasound to be balanced from input to output so balanced connections should be used when possible. In addition to offering two sets of five-way binding posts for biwiring, toggle switches are present for normal or reduced bias levels and normal or lifted ground operation. The AC cord is removable and the Halo ships with a nice pair of white AC cords.

#### Inside

Much information is readily available on Parasound's web site and even in the user manual about the design philosophies and quality of parts used in the JC 1, which is a good sign. They're proud of their work and all that goes into the JC 1. I'm always suspicious when it's hard to find information on a product's design, or if the manufacturer is evasive about how a product is built.

JC 1 amplifiers are balanced from input to output, with differentially configured JFETs used in the input stage. The driver stage uses push-pull MOSFETs and is followed by nine pairs of Sanken bipolar transistors. Parasound's literature makes much of their belief that MOSFETs are more "tubelike" and that they produce less odd-order harmonic distortion making more natural and less fatiguing sound.

Another aspect of the JC 1 design intended for greater musical purity is a Class AB output stage rated to operate in pure Class A up to 25 watts. Operating that high at Class A should mean that the JC 1 will be in Class AB only during demanding music or movie passages. *Stereophile* measured this amplifier and

found that the JC 1 exceeds that specification, and indeed exceeds virtually all of its specified power ratings. Built like a tank, the JC 1 apparently backs up its swagger on the test bench.

One distinction between this amp and some of the other solid-state designs reviewed in this issue is that the JC 1 does employ a modest amount of global negative feedback (29dB).



Advocates of judicious amounts of negative feedback fed from the output of the amplifier back to the input will likely cite higher power, lower distortion and better bass control as advantages. Opponents of feedback, like Ayre's Charles Hansen, will tell you that any global feedback causes time domain distortion that sacrifices musical purity in exchange for its positive effects.

The JC 1 power supply consists of a massive toroidal transformer in a steel canister to isolate it from the rest of the circuitry. Each JC 1 employs four electrolytic filter caps rated at 33k microfarads each in the high-current power supply, totaling 132,000µf capacitance per monoblock. Smaller polypropylene bypass caps are also used to filter the DC supply of noise from the incoming AC.

Looking inside the JC 1 the only thing that was less than impressive was that it had what looked like a mile of wire in it, a lot which connected to the circuit boards using plastic jumpers. Nothing to draw any conclusions on, but most designers I know would eliminate all the wire in their amps if they could.

As you've read in this **Journal**, power amplifiers need to deliver lots of pure current to adequately drive loudspeakers and

avoid clipping that can deleteriously affect sound quality and even damage your speakers. To provide that an amplifier needs a big power supply, large voltage rails, and lots of powerful output devices. The Halo JC 1 meets all conceivable criteria.

### Performance

The Halo JC 1s have a very visceral sense of raw power that none of the other amps here exhibited. You're aware immediately that they are exerting complete control over the loudspeaker in a muscle car kind of way, and yet they always behave like they're idling. They're tonally neutral and have excellent extension at both frequency extremes.

Compared to the Theta Dreadnaught the JC 1s are just a little lean in the mid- and upper bass, but also exceptionally quick, detailed and articulate in this same band. And, if anything, the zero feedback Theta is just as warm in that region so it could be that the JC 1s are simply right on the money.

The slightly austere mid- and upper bass performance reveals the midrange as just a touch on the cool side, but very clean and resolved. The JC 1s are as quick and lively as can be, and yet never is there anything approaching strain nor are any of the "G" words remotely applicable (grit, glare, grain). They're just pure and clean and naturally extended.

Comparing the JC 1s to the zero feedback amps from Ayre and Theta was quite interesting. The biggest differences I perceived were in spatiality, imaging and overall perspective.

Spatially the JC 1s showed excellent lateral focus across the soundstage, delineating players from side to side with precision. Front to back, the soundstage was flat compared to the Ayre and Theta amps, and they compressed musicians to a single plane rather than layering them from front to back with convincing foreground and background perspectives.

The Ayre and Theta amps were more holographic with image density and air that was more natural and convincing. The JC 1s sound a little more like a hi-fi system to my ears, but it should be noted that my tastes place the utmost priority on image focus and palpability. The Parasounds do have other attributes that some listeners might prefer just as strongly.

On the Parasound side, the JC 1s were noticeably more pow-

erful than the other amps, and completely effortless in their rendering of prodigious dynamic contrast. Their sense of attack was excellent—very fast, if just a little exaggerated in comparison to the slightly more natural sounding Ayre and Theta amps. The JC 1s also provided a superior combination of bass extension, authority and control without sounding as light in the loafers as the Ayre. The Parasounds will drive any conceivable loudspeaker load to high volumes with dynamics to spare.

### Conclusion

True to my initial impression, the Halo JC 1 is a carriage trade-quality product at a real-world price. My own preferences lean toward the more musically pure and spatially convincing sound of the zero feedback amps reviewed here, but that's a matter of taste more than a reflection of quality. For many of you out there the JC 1 offers the combination of speed, authority and ease that could be just the ticket, especially for those of you with large full-range speakers to drive. And the JC 1s will drive them! Those who would still seek out the Levinson and Krell sound should look at the Halo JC 1s before opening their wallets that wide. [APJ](#)

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**HALO**  
 by  
**PARASOUND**

*Richard Hardesty comments on...*  
**JC 1 Monoblocks**

*The Halo JC 1 monoblocks provide Levinson-like build quality and sound for far less money. If you own Wilson Speakers or JM Labs or Revels these may be your amplifiers. If you value three-dimensional imaging you may want to aim a little higher. The Halos make a sonic image that can be likened to a visual image projected on a CinemaScope screen—curved back in the middle yet flat with no real depth anywhere. The Halos are a great value when compared to Levinson and Krell. They don't measure up so well when compared to Ayre and Theta amplifiers, which sound better and cost less.*

## **NAGRA VPA** by Shane Buettner

*At every year's CES extravaganza the standout experience is spending time at the cluster of rooms dedicated to Audiophile Systems Ltd., the importer/US distributor of such brands as Arcam, dCS, Nottingham turntables, Verity Audio speakers, and Nagra electronics. Spending an hour or so with ASL's Gary Warzin is a multifaceted and always entertaining experience. The products ASL brings into the US are well designed top performers and it's always fun to see what new products ASL's innovative companies are offering.*



Over successive years Gary has made a smashing smoke and mirrors presentation (literally) on Acoustic Energy's Aego multimedia speakers (Dick now uses these with his Apple computer), escaping from a real straitjacket before our eyes without missing a beat while delivering a sales pitch on ASL's products! Gary claims the straitjacket was purchased and is not from a hospital stay of his own. That's his story, he's

sticking with it and I won't contradict a man who can escape from a straitjacket!

At these CES shows we noticed that outstanding sound follows the Nagra products from room to room. Nagra is a Swiss company founded in 1951 that has a long-storied reputation in professional audio, especially regarding their reel-to-reel tape recorders, which have been Hollywood/film industry standbys for decades earning Nagra several Oscar® Technical Merit Awards.



Nagra's efforts in high-end consumer audio have been nearly as well received. Their line today includes solid-state and vacuum tube power amplifiers, tube preamps, reel-to-reel tape decks and even a high-end DAC. Notable of their line is that some of their products use rechargeable batteries so they run on pure DC.

The focus of this review is the VPA power amplifier. VPA is a diminutive tube monoblock that offers 50 watts of pure Class A power in a fully balanced topology with no feedback for \$15K per pair.

### Outside

"Swiss jewelry" is a term used in Nagra's literature and you'll see it for yourself when you lay eyes on the VPAs—they're simply gorgeous. The VPA is a 29-pound machined aluminum box "about the size of a large dictionary" with two push-pull output

tubes on the top of the cabinet. Each tube is encircled by protecting rods of varied height and the front panel features a retro-styled knob to power the amp into mute or full output. The overall aesthetic impact of this product is as beautiful and awe-inspiring as I've seen, rivaling Theta's Citadel albeit in an entirely different fashion.

The back panel features single-ended and balanced outputs and jumpers select the operating mode. Four-, 8-, and 16-ohm taps are provided and the VPAs employ a unique load-matching metering system to help select the tap that will work best with your speakers.



The front panel meter on each VPA shows a red pointer for the cathode current and a black pointer for the anode current. During music playback if the two needles superimpose and move in unison the impedance should be correct. If the red pointer is out in front the user manual suggests using a lower impedance tap. I found few sonic differences between the 4- and 8-ohm taps, and suggest listening as a guide and experimenting some.

Nagra has also provided a fast and simple way to adjust the bias of the output tubes using two small screws on the sides of the amp cabinet. With no signal into the amplifier and the mute button engaged, the red pointer (cathode current) should be aligned with a small screwdriver to fall in the middle of the designated green zone on the front panel meter, which shows the front tube settings by default. Pressing the black button on the front panel shows the rear tube's cathode current and that is also adjusted with a screwdriver on the side of the cabinet (the potentiometers for the front and rear tubes are positioned one above the other). Like I said: fast and simple!

### Inside

The VPAs use tubes for gain exclusively and, while the large 845 output stage tubes that adorn the top of the cabinet must be installed separately, the input/driver stage tubes are pre-installed in the aluminum case.

The Nagra uses a fully balanced, zero feedback topology and, according to Nagra, operates entirely in Class A for all 50 watts of its power delivery. The VPAs are unusual in that they use toroidal output transformers that Nagra refers to as proprietary. Detractors of this approach note that, while toroidal output transformers have excellent high frequency response, their bass performance may suffer as the transformer saturates. For their part, Nagra claims their proprietary design avoids low-frequency saturation to provide bass of "absolute authority."

### Performance

As with all of the amps in this survey a signal generator and volt meter were used to determine the -3dB downpoint in the bass to ensure proper matching with the Vandersteen Model 5A speakers that are my reference. The input impedance of the Nagra proved to be far off the specified <100k.

The VPAs' input impedance was closer to 50k using balanced connections based on our measurements of the -3dB point. This dramatically affects the bass blend for a system using a passive high-pass filter and powered subs.

The Nagras exhibited spectacular sound, with a very deep front to back soundstage and knockout, spectacular imaging. Vocalists and musicians were holographic and even ethereal in the way they came together and hung suspended in space, completely separated from the speakers' physical positions.

***“The Nagras exhibited spectacular sound with a very deep front to back soundstage and knockout, spectacular imaging.”***

This aspect of the VPA amps' sound is likely to set the hook very deep in a lot of listeners. The only thing that betrayed this illusion somewhat for me is that, while the imaging was incredibly dimensional, it didn't have quite the palpability or realism of what I heard from the Theta or Ayre amps. It sounded wonderful, and this is a nit I'm picking here for sure. But in spite of how exciting the VPAs' sonic images were, somehow I was still aware that I was listening to a hi-fi and not as convinced that musicians were there in the room with me as with those other amps.

Tonally the VPAs were somewhere between the ARC and VTL tube amps. Not quite as lively and resolved through the midrange as the ARC, and perhaps not quite as distant in perspective as the VTLs. The midrange had some tube “ta-da” and a very visceral and immediate feel to it. Although it fell a bit short of the ARC's drawing of shade and texture, particularly with vocals—I could hear more throat sounds and minute details with the ARC—the Nagras' sound was very accessible and engaging if not outright magical.

The VPAs' bass was very good, a little fuller than the ARC and a little tighter and lighter than the VTLs. The top end extension was terrific for a tube amp, nearly in the league of the VTLs. The Nagras' dynamics and power were fine with light material like jazz quartets, with surprising pop (for a 50-watt amp) in the

drum kit. But with rock and orchestral pieces I could hear the Nagras being pushed at moderately high volume levels. Although the VPAs showed better overall clarity than the ARC, at times a gritty distortion was evident at higher volume levels with more challenging material. This amp is going to be happiest with efficient loudspeakers or judicious volume levels with some material.

### Conclusion

The biggest knock on the Nagras is that they're expensive at \$15K per pair and come with some caveats based primarily on their power output. If you're a guy or gal who lives for jazz quartet, or who uses highly efficient speakers, the magic that these little Swiss jewels impart could quite simply floor you with their ethereal image focus. If you're a little bit more rock-n-roll, or into reproducing symphonies, the power limits might be more of a limitation than you can stand.

I know it's unfair to some extent to review a 50-watt amp and expect it to be anything more than it is. But I was so impressed with demos of these amps that I wanted to find out more. There are purely magical aspects if the Nagras' limitations don't apply to you. [APJ](#)

*Manufacturer Information*  
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*Richard Hardesty comments on...*

**NAGRA VPA**

*Nagra VPA amplifiers set a new standard with got-to-have-'em looks. Owning these amplifiers would be like owning fine jewelry—even if you never turned them on. Their almost-ethereal imaging might make up for the fact that these amps have insufficient power for dynamic music material played on medium sensitivity speakers. The tubes glow too brightly for use with a video presentation. Within their limitations the Nagras are still great amplifiers. If I were rich I'd have a pair of these in my bedroom system.*

### THETA CITADEL MONOBLOCKS

by Shane Buettner

*Those who have been reading the **Journal** for any time at all know that Dick Hardesty has been hooked on Theta Dreadnaught amplifiers for the last three years and counting, and that both he and I bought them and use them as our reference power amplifiers.*

*The Dreadnaught was based on a circuit topology that Theta hired Ayre's Charles Hansen to design, and both Jim White (now with Aesthetix) and Dave Reich (formerly of Classé and McCormack) worked on it at Theta's end. If that's not premium design talent I don't know what is. The Dreadnaught was something of an instant classic, a modular multichannel design that holds as many as five channels (or ten half-power channels) that sold for under \$7K fully loaded (actually \$6,750 for a 5-channel Dreadnaught II).*

The Citadel is a no-holds-barred monoblock based on Dreadnaught's amplifier modules. It's more powerful at 400 watts per channel into 8Ω, boasts some parts-quality upgrades, and is wildly more expensive at \$15,800 per pair (as reviewed). But who wouldn't want an amp that promises to be a more powerful, more refined version of one of the best of the best solid-state amps available?



#### Outside: Form and Function

Theta's Citadel is one of the most gorgeous pieces of industrial design I've laid my eyes upon. It's taller than I expected, and parked up next to my speakers it looked imposing, stately and beautiful. It's exactly as a statement product should be and although we

all try to pretend it's not about the gear, there's a commanding allure about the physical appearance of a component like the Citadel.

Citadel has the curvature of Theta's latest designs and its brushed aluminum front panel is sculpted into gentle waves. Each pair is designed to be set up left and right aligning the narrow extrusions on each front panel to the inside. Each extrusion runs about 2/3 of the way up the face and houses three LEDs and a badge with the winged Theta logo.

The Theta logo is the power on/off button and the LEDs are status indicators. One indicator is power/standby, while the thermal indicator illuminates when dangerous temperatures are reached in the amplifier. The "DIG IN/LOCK" indicator and a button below the LEDs marked "ANA/DIG INPUT" refer to an as-yet-unrealized potential of Citadel to house a DAC board and accept digital input signals directly.

The side panels and top of Citadel are adorned with curved vents. The side panels are both lined with the same "advanced interlocking polymer" used on the Aesthetix Calypso and Rhea front end components (see review in **Journal** #10) that allows them to be removed with no screws.

This stuff really isn't Velcro™ even though that's how it behaves, which makes for a colloquially intuitive description of



what it does. Apparently the key difference between this material and Velcro™ is that the advanced polymer won't separate when pulled straight off (you have to work it side to side to get separation) and it actually damps vibration and resonances in a way that standard Velcro™ and especially screws don't. Interesting and cool.

In addition to two large handles, Citadel's back panel has one each balanced and single-ended inputs with a toggle switch to select between them. There are LEDs for thermal

overload protection and one each to indicate if the positive or negative rail fuse has blown. The main power cord inlet and power switch are on the lower left of the back panel. On the lower right are the digital power cord inlet and main switch for powering the optional DAC board Theta plans to offer in the future that will be housed in an open bay on Citadel's rear panel.



There are remote trigger inputs and RS232 connectors on RJ-45 and DB9 connectors. The binding posts are big, heavy-duty proprietary things, designed by Theta's Dave Reich, that have to be tightened down with an Allen wrench (Citadel ships with a nice one with a logo handle). The pair I auditioned came equipped with a second set of binding posts for biwiring—a \$300 per unit option. The only issue I had

with these posts is that they're loaded from the sides and not the bottom, which makes them a little harder to access and leaves more pressure on thick speaker wires when they're hanging sideways with the spades locked down. Nevertheless, the connection was exceptionally tight and solid, which means it does what it's supposed to do.

### Inside: The Design

The Citadel is based on the Dreadnaught's amplifier module, which is essentially a bridged solid-state stereo amp module in a fully balanced configuration. The input devices are JFETs, the driver stage devices are MOSFETs, and the output devices are bipolars and there are sixteen of those suckers. For Citadel the modules have upgraded parts that are tweaked to tighter tolerances "by hand." Like Dreadnaught, Citadel is a zero global feedback design.

The power supply of the Citadel is tweaked to deliver higher rail voltage for increased current output. Dave Reich confirmed that the sixteen bipolar output devices are still more than ample to deliver the additional current generated. Citadel uses larger heat sinks to dissipate the heat created by the process and

actually runs quite cool compared to Dreadnaught. Each Citadel uses an EI core transformer rated at approximately 1kVA and two chokes on the high current power supply to quench noise. Each Citadel has two filter cap banks rated at a total of 160,000 microfarads capacitance.

Citadel's power ratings are interesting. While the ratings are 400, 600, and 800 watts per channel into 8, 4, and 2Ω, respectively, the power rating is specified at <2% THD+Noise instead of the typical <1%. (Theta's own Dreadnaught, for example, is rated at 200 watts per channel into 8Ω at <1% THD+Noise.) Relaxing the distortion figure on the power rating could be a bit of specsmanship on Theta's part to make Citadel seem more powerful on paper than it really is.

### Performance

The Citadels I auditioned had been used before but they still needed time to settle into their ultimate performance envelope within a couple of days. Over that time they continued to gain front to back depth and top end extension in particular. I bring this up because when I purchased my Dreadnaughts new from Theta they sounded very soft and almost dull for several weeks. After a month of continuous use they finally opened up. If you buy them based on the recommendation I'm going to make here, please don't send me a nasty email until they've run for a while. Let's talk about what you'll hear after that.

The Citadels are everything that the Dreadnaught is—with just a pinch more including overall refinement. While there isn't any single way in which the Citadels are dramatically better than the Dreadnaught, the total listening experience adds up to

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***“The Citadels are everything that the Dreadnaught is—with just a pinch more including overall refinement.”***

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more than what the number of small (but noticeably real) improvements suggest by themselves. The Citadels have better bass, improved midrange resolution and an airier, more extended top end. They have layers of front to back depth, resolution and utterly convincing image focus and dimensionality.



Other components in your system will set the sonic boundaries of the soundstage, not these amplifiers.

The Citadels are just as focused as Dreadnaught, but with images that are larger, more rounded with slightly more convincing air surrounding them. Not only do musicians and instruments throw way back in the soundstage, other players are clearly drawn out in the foreground on separate spatial planes.

The sound is also as pure and musical as I've heard from solid-state, with the natural, liquid, non-fatiguing sound of tube gear. The Citadels are more refined than Dreadnaught, with a sound that is just impossibly sweet and purely musical for an amplifier that's this revealing and high in resolving power. Part of the Citadels' magic is unquestionably in how quiet they are; they're much closer to the standard set by the Ayre amplifiers in that regard than the Dreadnaught.

The Citadels sound more liquid, never showing anything resembling grit or grain. That characteristic lack of grain or glare seemed to me the most obvious form that the Citadels' higher power rating assumes as well. They sound a bit more powerful than Dreadnaught, but not twice as powerful. The additional power results in slightly improved bass weight, control and articulation. But more than that, the Citadels seem to hold together with more grace during loud, complex passages.

Citadels never sound as brutishly powerful as the Halo JC 1s, for example, but neither do they run out of gas or veer into any form of harshness or edginess that would suggest a threshold being breached.

While the Dreadnaught is a great amplifier, and one I've been happy with for three years with other contenders coming and going with regularity, the Citadels point out its few weaknesses in ways that very few amplifiers have.

Taking nothing away from my Dreadnaughts, for the first time since I've had them there was a let down switching back to my reference amps! I say that takes nothing from the Dreadnaught because we're talking about a competitor that's got more in common than not, and costs substantially more. You'd be unlikely to perceive the shortcomings of the Dreadnaught except in direct comparison to the Citadels.

Standard operating procedure for me during a review is to lis-

ten to the review product for a length of time then, as the review winds down and I feel I've gotten a handle on it, to replace the review product with my reference gear for a final comparison. With the Citadels, I found myself putting this off for days on end—I just didn't want to replace them until I'd heard a few more favorite recordings. I think that, more than anything, expresses my feelings about these amps.

### Conclusion

Value must be part of the equation in any review and it's always the trickiest question. The Citadels are the finest amplifiers I've had in my system, period. As excellent as the other amps in this survey are, the Citadels are a cut above them all. But they cost multiples of Dreadnaught's price and the obvious question is whether they sound that much better.

Dreadnaught is good enough to make that a legitimate and tough question. All I can say is that the Citadels are better in some quantifiable ways, and we're in an industry where increased performance can often be obtained only by wildly disproportionate spending. I think this speaks well of Theta's efforts on both counts. The Dreadnaught is an amplifier that can be bettered only by spending much more.

But given the additional design budget, they've managed to make something that sounds even better still and the Citadels are an astounding aesthetic achievement to boot. Perhaps the best way I can make my feelings clear is this: if I could afford them I'd buy the Citadels in a heartbeat and I wouldn't look back. **API**

*Manufacturer Information*

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**THETA  
CITADEL**

*Richard Hardesty comments on...*

**MONOBLOCKS**

*The Theta Citadels are the best amplifiers I've heard. They provided dead silent backgrounds like the Ayre, holographic imaging that used to be strictly the province of tubes, bass control and impact that you could never get from tubes, power and dynamic contrast along with air and high frequency extension that used to be available only to those who would sacrifice subtle detail resolution in the midrange.*

# THETA DREADNAUGHT II

by Shane Buettner

*How could I not be compelled to listen to Theta's sequel to my own reference amp? Theta beefed up the power supply and revised the circuit board used in Dreadnaught's amplifier modules in order to get a more powerful, gutsy sound. Dreadnaught II is very nearly the same price as its predecessor: \$6,750 for five channels. Its power rating is a little higher at 225 watts per channel into 8Ω, compared to Dreadnaught's 200 watts, but sounds more powerful still. While that makes Dreadnaught II an unquestionably better amp in home theater terms, is it on equal footing with its predecessor with music?*

### Outside

Dreadnaught II is cosmetically similar if not identical to the original Dreadnaught, which is to say it remains an attractive if not gorgeous looking component. They're both available in silver or



black brushed aluminum. One significant improvement is that rail fuses are now easily accessed and changed at the rear panel. As one who's removed a coffee can full of screws from Dreadnaught's top cover to change a fuse I say this is a good thing.

Dreadnaught II no longer has a switch on each channel module for balanced or single-ended operation; it's plug and play. Each module is still assignable to stereo or surround operation, which is selected on the front panel. If a channel is designated as "surround" when stereo mode is engaged that amp channel's output stages aren't hot, decreasing the load on the power supply. Cardas Rhodium speaker terminals are used and are conveniently located at the top of the rear panel.

### Inside

Let's talk first of the commonalities between Dreadnaughts I and II. Each is configured to hold between two and five channels. Each channel is a balanced, bridged stereo module, fully balanced from input to output with zero global feedback and its own bridge rectifier. Each module uses JFETs on the input stage, MOSFETs in the driver stage and sixteen bipolar output devices.

Dreadnaught's main circuit design was done by Ayre's Charlie Hansen, with Jim White (now of Aesthetix) and Dave Reich being part of the team at Theta to bring that design to fruition. Dave Reich has done design work on some outstanding amplifiers at both Classé and McCormack. Dave is now Theta's general manager and designer and the changes in Dreadnaught II are of his design.

Changes include upgrading the MOSFETs used in the driver stage to the same devices used in Theta's Citadel monoblocks. The circuit boards of each module were changed to four-layer boards, which allows more room on the boards and, according to Reich, provides greater sample-to-sample performance integrity than Dreadnaught's original board.

The greater real estate on the board allowed Reich a separate dedicated ground plane layer, more power supply filter caps (increasing capacitance), and wider traces for the voltage rails. Where Dreadnaught has a single EI core transformer rated at 2.2kVA, Dreadnaught II uses two toroids rated at 1kVA each. The toroids are in parallel and essentially behave as a single large toroidal transformer.

### Performance

The first thing I noticed is that Dreadnaught II is surprisingly more muscular than its predecessor, far more than the 25 watts per channel specified power increase would suggest. Bass control is better and—especially with home theater material—it's a much ballsier, more powerful sound.

I didn't have the Dreadnaught II on hand to compare directly with the Citadels, but my memory says it sounded nearly as powerful as the mighty monoblock. But what had made Dreadnaught I so special in my opinion is not its power—there are plenty of powerful multichannel amps out there—but its musical resolution and soul.



### Conclusion

As you'll read in this survey Dreadnaught more than holds its own against every high-end competitor we've found so far, stereo or monoblock. And Dreadnaught II is not quite its predecessor's equal in depth, dimensionality and midrange resolving power.

On vocals in particular I felt I could hear a little more texture and low-level detail with Dreadnaught I that made music listening a more involving and convincing experience for me. I also felt that Dreadnaught I was more holographic and had more convincing and lifelike image focus, albeit by a hair. Keep in mind that these are trifles that only the highest resolution systems will reveal and that Dreadnaught II is overall an outstanding performer at an amazing price point offering five powerful channels of amplification that will embarrass many high-end competitors' stereo or monoblock offerings at the same price or higher. [APJ](#)

*Richard Hardesty comments on...*

## THETA DREADNAUGHT II

*The Theta Dreadnaught II was a slightly better home theater amplifier than its predecessor with more power for noticeable improvements in dynamics and bass slam. I found the Dreadnaught I to be more satisfying as a music amplifier but the Dreadnaught II is damn good nonetheless.*

## VTL 450 SIGNATURE MONOBLOCKS by Shane Buettner

*Vacuum Tube Logic was formed as something of a "prosumer" company in 1986 keeping its feet in both the professional recording industry and high-end consumer electronics. These days, under the stewardship of cofounder Luke Manley, VTL's singular pursuit is designing and manufacturing state-of-the-art vacuum tube preamps and power amplifiers.*

For this issue of the **Journal** VTL sent over a pair of MB-450 monoblocks. This powerful monoblock has been in the VTL line practically since the company's founding, dating back to the late 1980s. The MB-450 has been gradually refined to its current form as the MB-450 Signature and sells for \$10K per pair.

This latest generation features an upgraded power supply and a new input stage. VTL's prior iterations can be factory-upgraded to current spec. The MB-450 is rated to deliver 450 watts per channel into 4Ω in tetrode and 225 watts in triode (the 8Ω ratings are 200 for triode and 339 for tetrode). The numbers and VTL's literature suggest this amplifier will deliver solid-state-like control and dynamics with the soulful effortlessness of tubes.

### Outside

The MB-450s are much heavier than their relatively small size suggests—85 pounds each. The review set was finished in rich



black with a look reminiscent of the '80s. Not exactly big hair and miniskirts but a vintage look for sure.

The front panel has a power button tucked away on the bottom right and large vent slots of varying width. When the amp is powered up the tubes' glow is visible, which is pretty cool. The

top and back covers are vented as well to keep the MB-450s running cool.

The back panel features single-ended and balanced inputs and a single pair of five-way output terminals (my review sample was actually made with WBT connectors, which are required in Europe, but VTL claims typical production units sold in the US have standard heavy-duty five-ways). One small toggle switch selects the balanced or single-ended inputs, and another switch selects tetrode or triode mode. The user manual stipulates that the amp should be powered off completely when switching between tetrode and triode.

### Inside

Let's begin at the beginning. The MB-450 Signature uses the same fully differential input stage circuits as VTL's Reference series Siegfried monoblocks (\$40K per pair!), an upgrade over previous iterations of the MB-450. The tube complement uses one 12AT7 in the input stage and a 6350 in the driver stage, and no fewer than eight 6550Cs in the output stage. Lots of power, lots of tubes.

The 6550Cs are five-element tubes with four active elements operating in tetrode mode. When switched to triode one tube element is essentially joined to another with three elements effectively in operation.

Common to the entire Signature series of components and another improvement over previous models is the VTL Signature transformer. VTL claims that this EI core transformer increases bandwidth and results in superior square wave performance. They also believe that this "Signature" transformer improves bass performance without sacrificing any top end resolution.

Bias can be adjusted easily on each of the MB-450 Signature's eight output tubes with a voltmeter and a screwdriver after removing the top cover. Be very careful when performing such an adjustment—if you're not comfortable doing it yourself, take it into your dealer. A last notable detail is that the MB-450 Signature uses approximately 12dB of global feedback.

### Performance

The MB-450s have an arresting ease about them, a graceful sense of power and unrestrained dynamics. They sound com-

pletely free and open, separating the music from the system. The MB-450s have an exceptionally pure and crystalline sound.

Unlike the other tube amps reviewed in this issue there was no immediate sense of improved clarity when switching from the MB-450 amps to the solid-state amps in the survey. A reason for that must be the MB-450's top end, which has the best extension I've yet heard from a tube amp, an area in which the VTLs clearly had the edge on the other tube amps reviewed here.

The MB-450s also showed considerable bass weight, with a bottom end that was slightly loose compared to the solid-state amps. The ARC sounded faster in the mid-bass, but also leaner and lacking in richness. Astonishingly, while the VTLs were clearly extended on top, they didn't resolve as much midrange detail as the other amps reviewed here, including the ARC VT100 MKIII.

In addition, while the soundstage overall was impressively wide and very deep front to back, it was also a bit distant in per-

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***“ ...it had a pure and effortless sound about it that was simply remarkable...”***

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spective. In other words, while the soundstage was deep, the VTLs seemed to push everything far back on the soundstage and didn't reveal some players on separate front to back planes as well as some of the other contenders.

But I haven't described all of the MB-450s thrills yet either. While I mentioned that this muscular amp had dynamics, I think it puts things in perspective to note that this amp at least equaled if not exceeded the dynamic punch and contrast of the solid-state amps (except for the Halo JC 1). And in doing so, it had a pure and effortless sound about it that was simply remarkable and literally dumped the other tube amps we looked at.

And that's in triode mode. Switching to tetrode on the VTLs' back panel made for an interesting set of changes. The power and dynamics increased further still, and the bass tightened up



considerably and seemed to extend lower.

While the measurements VTL provided show improved top end extension in tetrode mode, and their literature suggests higher resolution, I heard tetrode as more of a tone control than a resolution enhancer. Tetrode mode seemed to emphasize the midrange some, but provided slightly decreased focus and dimensionality. Further, while listening to female vocals I was clearly hearing less retrieval of fine detail and texture—there was less real detail in the midrange.

A more mysterious aspect of the MB-450's sonic signature was how it dealt with slowly paced but impeccably timed music. Listening to the song "New Favorite" on the *Live SACD* by Alison Krauss and Union Station, the VTLs slowed the pace of the song substantially compared with the other amps, and made the band sound arrhythmic to boot. Quicker tunes were delivered with the requisite foot-tapping rhythm and pace, and the VTLs offered a good sense of overall speed. But with slower music these strange phenomena were clearly evident with the VTLs in the system although I can't even speculate as to the cause.

## Conclusion

The VTLs do nearly everything right if not spectacularly well. They are amazingly open and free sounding with dynamic scale that tube amps, even powerful tube amps, simply aren't supposed to have. Extension at both frequency extremes is outstanding and the MB-450 Signatures are remarkably pure sounding and free of tube colorations.

These amps offer much of the controlled, clean power of solid-state with the richness of tubes. They aren't the last word in midrange resolution, but they image like a mother and never run out of gas. They can be recommended without reservation as tube amps that will power a broad variety of loudspeakers and drive them full range under any conditions with any brand of music. **APJ**

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*Richard Hardesty comments on...*

## VTL450 SIGNATURE MONOBLOCKS

*The VTL MB-450s offer incredible clarity for tube amplifiers and appear to have virtually unlimited power and unusually extended high frequency response. Their Achilles' heel is timing-related. Rhythmic involvement is an important aspect of my connection to music and these amplifiers fell short of my expectations in that regard. Their performance was exemplary in all other areas and I may be the only one who hears a problem with rhythm and pace.*

## QUICK HITS

by Shane Buettner

### Anthem PVA 7

*Anthem's components are designed and manufactured by the same company that makes Paradigm gear in Canada, and at one time this company also marketed the renowned Sonic Frontiers line of high-end audio gear.*

The Anthem PVA 7 was designed to complement their AVM 20 7.1-channel digital controller and I reviewed both as a package



for *The Perfect Vision*. While both products were excellent for the money, the PVA 7 was a real standout at \$1,499 for a seven-channel amplifier, much better than competing products I've heard near its price.

### Outside

The PVA 7 I reviewed was as plain a silver box as you'd want to see—it's also available in black—with only a small power button on the front panel. Only single-ended inputs are provided to each of its seven channels, and its five-way binding posts accept even large spades easily.

## Inside

The PVA 7's insides are comprised of three stereo modules and a single mono module specified for the center channel. Each channel is rated at 105 watts into 8Ω, and each module has its own dedicated heat sink. The chassis has a single toroidal transformer rated at 800VA and a total of 100,000 microfarads of capacitance. Each channel has four bipolar output devices.

## Performance

At barely over \$200 per channel the Anthem amp floored me with the depth and delicacy of its sound. While not quite as powerful or ballsy as the ATI amps you'll find in this price

***“At barely over \$200 per channel the Anthem amp floored me with the depth and delicacy of its sound.”***

range, its resolution and pure musicality are superior, in my opinion.

The midrange had a striking clarity due in part to the amp being a little light in the low end. Even with that slight low end the PVA 7 sounded well balanced and integrated.

Ironically, while it's a multichannel amp designed for home theater use, I remember thinking it was much more a music lover's amp than a comparably priced Rotel I'd heard, which was fat and slow in the bass, clearly veiled in the midrange, and not nearly as dimensional in focus. The PVA 7 sounded organic in timbre, musically cohesive, and imaged with remarkable focus. A steal at its price and a real find!

## Arcam P7

*The \$4,500 Arcam P7 was born of a million dollar development program by Arcam that yielded this seven-channel power amplifier and its partner surround sound controller. I reviewed both for The Perfect Vision and while I was knocked out by the AV8 controller, the P7 left me wanting for an amp at its price.*

## Outside

The P7 is a utilitarian box, finished in grey or black. Channel assignments are marked clearly on the back panel, which features single-ended inputs only. Following the channel assignments is key since it results in the left and right speakers having access to a dedicated transformer when listening in stereo—Arcam is a stereo company first and all their products are logically designed with stereo music listening as a priority, even when multichannel is accommodated as it is here.

## Inside

The P7 is THX Ultra2-certified to deliver 150 watts per channel into 8Ω (and 230 watts into 4Ω). Two toroids rated at 1500VA are used with separate windings for the various channels. When run in full seven-channel mode each transformer feeds three channels, with the center channel pulling one winding from the transformer for superior “load balancing.” A cooling fan is included but unlikely to operate often, and each channel uses four bipolar output devices.

## Performance

It's one of my pet peeves, but after much experimentation I've come to believe that 6.1- or 7.1-channel surround sound is totally superfluous in most rooms, even for movie soundtracks. In a really big or really screwed up sounding room, ok, maybe. But for the most part I think the various forms of “extended surround” are ways for manufacturers to sell receivers and controllers to people who already have them, not to mention that selling more amplifiers is always better for manufacturers. And if you're a company like Arcam, competing with the mass market controllers and AVRs, you have to offer the same bells and whistles.

I really think it's too much to ask of a power amplifier to have enough power supply guts to drive seven channels at high levels. Five channels are a lot, seven are too many, and that's what I heard here.

While the P7 showed a mostly smooth and pleasant sonic character, it was also dynamically compressed compared to Dreadnaught. I got much greater dynamic swing and impact out of the AV8 controller when driving my Theta amps.

Even in stereo mode the P7's bass was weaker than I expected,

and it had lower midrange and treble resolution and only so-so imaging. I've heard better performance for less money and I can't help but think Arcam might have done better offering a more powerful five-channel amp, with a stereo amp as an add-on for those who simply must have seven-channel surround sound.

## BAT VK-6200

*Back when we wrote for Widescreen Review Dick and I both took a keen interest when a company with audiophile roots ventured into home theater, seeking products that would elevate the aesthetic. The BAT VK-6200 is one of the products I encountered in that quest.*

While Balanced Audio Technology is known primarily for two-channel tube components, they also make a wide range of



solid-state products, including the big, bad VK-6200 multichannel power amplifier. The VK-6200 can be configured with two to six channels, has zero global feedback, and costs \$4,995 in its base two-channel configuration and \$1,250 for each additional channel (maximum of six). I reviewed a five-channel unit with a retail of \$8,745.

## Outside

The VK-6200 is one of the all-time backbreakers. The five-channel job I reviewed weighed in at 180 pounds. The VK-6200 is good looking in an extremely “guy” way, with silver and black aesthetics made of aluminum that match much of BAT’s line. It looks good and it puts the “heavy” in heavy-duty.

BAT sees this amp as a premium solution—including high-end custom installs. The VK-6200 is heavily vented in line with a

major design goal: to keep it running cool even when tucked into an equipment closet or rack.

The back panel features balanced and single-ended inputs for each channel and toggle switches to choose the proper mode of operation for each. The speaker terminals and AC inlet are on the bottom of the panel which makes connections tight with large speaker wire and terminations. If the chassis is fully loaded with channels the power cord will almost certainly come into contact with the speaker wires. With good shielding on both cables that shouldn't be a big deal but I'd still prefer them not to be in contact just in case.

## Inside

Each of the VK-6200's channel modules is rated at 200 watts per into 8Ω and 400 into 4Ω. Each module has its own power supply complete with a dedicated 700VA-rated toroidal transformer. All transistors are bipolar, and each channel's output stage uses eight high-output bipolar devices. The VK-6200 uses zero global negative feedback according to its designer Victor Khomenko, but while most of the VK-6200's circuits are balanced the output stage is not.

BAT's Victor Khomenko also provided the design for Integra Research's RDA-7 multichannel power amplifier leading to speculation on the Internet and elsewhere that the Integra Research amp is a VK-6200 for less money (the RDA-7 is now replaced by the RDA-7.1, but originally carried a retail of \$5K). Let's dispel that myth right now.

The RDA-7 has two toroids rated at 800VA, is rated lower in power at 150 watts per channel into 8Ω, uses some global

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***“...excellent bass control and dynamics, terrific resolution through the midrange, and fine top end extension.”***

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feedback, and has only six bipolar output devices per channel. Compare that with the specs above and you'll see there's no free lunch there.

### Performance

BAT's VK-6200 is a very solid performing amplifier. It has excellent bass control and dynamics, terrific resolution through the midrange, and fine top end extension. It's an amp that doesn't do anything wrong at all, yet I never felt connected to it either.

Although it wasn't lacking any warmth per se, my own reaction to it was just a little on the cold side for reasons I can't readily identify. In all cases, when comparing it to the Theta Dreadnaught, the VK-6200 was right in there in every way, and in truth I think the bass was better controlled and the dynamics were at least as good if not better.

The VK-6200 has a lot of oomph in the power supply and it shows. But it also costs a lot more than the Theta. If home theater is your priority, and particularly if you're looking for a cool running amp to rack-mount in an enclosed room, the VK-6200 is a solid choice. For music I responded to the improved dimensionality and purity of the Ayre and Theta amps.

### Classé CAV-500

*Since Classé Audio was founded by Mike Viglas and Dave Reich in 1980 they've amassed a reputation for offering components of Levinson-like build quality and performance at less than Levinson-like prices. Nearly three years ago I was afforded the opportunity to review Classé's CAV-500, a robust power amplifier rated to deliver 250 watts per channel (into 8Ω) to each of its five channels. It costs a robust but not crazy \$7,500 and looks like it.*

### Outside

As with all the Classé gear I've seen, the fit & finish of the CAV-500 is as heavy (125 pounds!) and classy as one would expect. Heavy aluminum that's silver on the front and top, complemented with black on the sides where the massive heat sinks reside. Only an etched Classé logo and power button reside on the front panel.

On the back side are both single-ended and balanced connections. Removing the installed jumpers from the ground and negative pins activates balanced operation. The speaker terminals are heavy buggers that accept only spades.

### Inside

The big Classé uses MOSFETs in the driver stage and eight high-current bipolar devices (per channel) in its output stages. It's balanced from input to output and uses a single toroidal transformer rated at 2kVA that's housed in a big, thick "magnetic flux controlled" can (I think that's a rather fancy-pants way of saying it resists magnetic field interactions but it's hard to be sure). At the time I reviewed this amplifier for *Widescreen Review*, I couldn't get a lot of information on how it works.

### Performance

I found the big Classé to be an excellent power amplifier with both music and film sources. I used this five-channel amp as just that with multichannel movies as a source, and I also used it to biamp Vandersteen 3A Signatures for two-channel music listening.

In all conditions with all material the Classé was powerful and effortless, with powerful and articulate bass and very good spatial/imaging characteristics. Vocals had impressive texture and detail. This Classé amp fell just short of the layered resolution and musicality of the Theta Dreadnaught, but it unquestionably lived up to its high-end audio pedigree.

### Linn Klimax Solo 500

*The Klimax Solo is Linn's latest and greatest monoblock, featuring all that Linn has learned in the way of using efficient, powerful switch-mode power supplies. The Klimax is a no-holds-barred product with a price to match: \$9,500 each. Each Klimax is rated at 290 watts into 8Ω and 500 watts into 4Ω, and yet they measure only 14" by 14" and are just 2.5" tall. How much performance has Linn squeezed into this diminutive package?*

### Outside

The Klimax Solos make a stunning impression that's quite the opposite of most brutishly powerful amplifiers. These flat little aluminum boxes have a space-age wonder about them, fin-





ished in silver with a chassis formed by two massive pieces of aluminum billet.

The top piece is comprised of the front, side and top panels and hangs over the back panel and around the billet that is the bottom chassis. Small irregular gashes on the top cover allow what little airflow the Klimax Solo requires. On the front, below the Linn logo, an inlet like a lidded eye lights up a cool blue when the Klimax is powered up—and it does so only when an input signal is sensed. There is no manual power button.

The only downside of the Klimax's small size and rather stunning aesthetic is that the back panel is cramped for space, being short from top to bottom and having part of the top cover hanging over it. Or maybe my fingers are too big. A switch on the back panel chooses whether the single-ended or balanced connectors are live, but Linn isn't big on balanced circuits so you can bet it's not a truly balanced differential design from input to output.

### **Linn's Silent Power Supply**

A switching power supply is an intriguing option for a power amplifier because it can be smaller, run cooler and cost less.

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***“The most exciting thing about the Linn Klimax Solo 500 is its bone-crunching bass authority and articulation.”***

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Less size is required to generate the high current necessary to drive loudspeakers and consequently the massive amounts of heat generated by the process that must be dissipated. Much of the size and weight of a typical solid-state power amplifier are in power supply and heat sinks.

Linn's Silent Power supply rectifies and filters the incoming AC and generates a 300-350 volt DC signal. Lightning fast semiconductor switches (as fast as 20 nanoseconds, according to Linn) then switch on and off to “chop up” the DC signal into a high frequency AC signal. Linn claims power transformers can be much smaller since they deal with such high frequencies—

as opposed to a typical transformer, which sees 60Hz AC signals. Rectifiers and filter caps then convert the “waveform” back to a DC signal to drive Klimax's electronics.

Switch-mode power supplies are much smaller and more efficient and are often used in powered subwoofer applications. They're a little tricky for full-range amplifier designs because of the large amount of high frequency noise created by the switching process.

Switching noise occurs at high frequencies so typically the signal is low-pass filtered, which filters out the noise but also limits its bandwidth. In the case of the Klimax its -3dB point is specified at 60k. That's still well above the range of human hearing, but consider that many solid-state designs like Theta's Dreadnaught aren't -3dB until around 200k.

Does this bandwidth limiting, even at ultrasonic frequencies, somehow impact what we do hear down below 20kHz? Don't know for sure, but as you'll read below, while the Klimax sounds excellent in many ways it certainly isn't as open or extended on top as the Theta amps are. Can't help but wonder why.

The Klimax's circuit topology is extensively “surface-mount” with almost no wire anywhere. The output stages are Class AB using eight high-current bipolar devices. Each Klimax has a cooling fan that I never heard—either the amp never ran hot enough for the fan to engage or it wasn't loud enough for me to hear.

### **Performance**

The most exciting thing about the Linn Klimax Solo 500 is its bone-crunching bass authority and articulation. I've never heard this amp's equal in that regard.

My reference loudspeakers at the time of the Linn review were Vandersteen 3A Signatures with 2Wq subwoofers. When I ran the 3As full range it sounded like the subwoofers were still connected and in line! I heard bass from my speakers that I wasn't aware they could deliver. Not only was the extension greatly improved, the control these amps exerted over the bass and midbass was simply mind boggling in articulation. It made my 3As sound tighter and faster than I've ever heard them with amazing rhythm and pace.

I know that the rhythm and foot-tapping thing is a cliché with Linn gear, but in my experience it's true. Everything I've heard from them is pitch-perfect and masterfully emphasizes music's rhythmic flow. If you have a big full-range speaker this amp is going to control the low end and make that speaker boogie better than anything else I've heard.

On the down side, the Klimax Solos are very expensive at nearly \$20K per pair, and they lack top end extension, image focus, front to back soundstage depth and overall resolution. Although my reference Theta Dreadnaughts could not even come close to matching the low-end grip of the Klimax, it sounded like twice as much music was coming out of my system with the Dreadnaughts back in place.

The Klimax simply doesn't have the resolving power or focus of some of the better solid-state amps I've heard, which would be easier to swallow at a lower price point. Still, I wouldn't begrudge anyone who bought these amps because they are musically involving and they'll never be fatiguing or grating to listen to. I enjoyed the time I had with them and they're in a category of products that could be plugged into your system and will keep making music an infectious experience all the livelong day. [APJ](#)

## NOT RECOMMENDED

by Shane Buettner

### B&K 7250

*I'm a big fan of B&K's digital controllers, which are designed from the ground up and manufactured right here in the USA (Buffalo, NY). In 2001 I listened to what was B&K's top of the line multichannel power amp, the \$2,498 Reference 7250. It's rated to deliver 200 watts into 8Ω and 375 into 4Ω.*

### Outside

The Reference 7250 is a classic black box, with a vented top cover and entirely straight angles. Finesse isn't the name of the game here. Inputs are single-ended only and each channel features its own level control. Speaker terminals are for spades or bananas only.

### Inside

The B&K amp reverses the topology of many amplifiers by using bipolar transistors in the input and driver stages and five pairs of MOSFETs (per channel) for output devices. The power supply uses a single toroid rated at 1.5kVA, and six large filter caps are used that total 162,000 microfarads capacitance. Three heat sinks make for a total of 250 square inches of heat dissipation per channel.

### Performance

While the B&K 7250 offered lots of dynamic punch and slam, it also was hard in the midrange and on top, and exhibited glare at higher volume levels. The bass lacked pitch definition and articulation so rhythm and pace were noticeably and negatively affected, and imaging was so diffuse I remember double-checking the speaker wires to make sure I hadn't inadvertently wired the speakers out of phase (which I hadn't). MOSFET haze? Could be.

Either way, image focus was too poor to allow me to get involved with music, and while the B&K's dynamics are well suited to home theater use the grain and glare it exhibits at loud volume levels aren't. The 7250 amplifier has been discontinued but based on my experience with it, I'd avoid this amplifier and caution anyone considering any newer B&K power amps to do some very careful listening to determine if they exhibit any of this amp's deleterious sonic characteristics.

### Integra Research RDA-7

*Integra Research is the high-end brand of the Onkyo Corporation, and is not to be confused with plain old Integra either, which sits in between the Onkyo and Integra Research lines.*

The first products from Integra Research included the RDC-7 digital controller, RDV-1 DVD-A/DVD-V player, and RDA-7, a \$5K seven-channel power amp designed by Victor Khomenko of Balanced Audio Technology (BAT).

The RDA-7 even featured the BAT logo on the front panel! I should also mention that while the amp didn't light my fire, the RDC-7 controller was excellent for its \$4K price tag, delivering balanced ins and outs and surprisingly good sound quality.

### Outside

The RDA-7 amplifier is finished in a pewter color and its chassis is vented on the top and sides. Single-ended and balanced connections are on the back panel, with each channel offering a switch between operational modes.

### Inside

Rumors that this amplifier is simply a cheaper BAT VK-6200 are patently false. Read the VK-6200 review elsewhere in this issue of the **Journal** for the skinny on that. The RDA-7 is rated to deliver 150 watts per channel into 8Ω with all seven channels driven. It uses two 800VA toroids, one supplying three channels and the other supplying four.

Each channel has 40k microfarads capacitance and highly efficient heat sinks. In spite of its balanced connections, and the Balanced Audio Technology logo on the front plate, the RDA-7 is not balanced from input to output. So much for the brand name. The input and driver stage transistors are bipolar and the output stage of each channel uses six bipolar devices.

### Performance

I used the RDA-7 in a five-channel setup with four of its seven channels vertically biamping Vandersteen 3A Signature speakers. The RDA-7's overriding sonic characteristic is a cold, mechanical, dry sound born in part by the amp's anemic low-end performance. It was quite muscular sounding, even during taxing home theater passages, and imaged surprisingly well.

It's a better home theater amp than a music listening amp though. With music it's simply too dry and analytical to establish a firm emotional connection with the listener.

### Linn AV5125 Switch-Mode Amp

*Just before leaving Widescreen Review in late 2001 I wrote a review of Linn's \$3,950 AV5125 that was never published. The AV5125 is a five-channel amplifier rated to deliver 125 watts per channel into 8Ω and 250 per channel into 4Ω. Linn advertises the AV5125 as a switch-mode power supply amp with a "Class V" topology. Linn's literature claims this amplifier delivers "audiophile performance while minimizing waste heat."*

### Outside

Only single-ended inputs are supplied—and worse, the speaker terminals use connectors that I've never seen on any other amplifier and require an adapter from Linn. I didn't have any speaker cables with bare wire to which I could connect Linn's adapters (!) so I was forced to use Linn's own speaker cables about which I'm admittedly skeptical.

### Inside

In my review of the Linn Klimax Solo in this issue of the **Journal**, I mentioned that switch-mode power supplies are seldom used in full-range applications. The signal must be low-pass filtered to eliminate the high frequency switching noise created in the power supply.

Detractors of switch-mode power supplies for full-range amps would say switch-mode amps sound slow, dark and rolled off. On the positive side, due to its use of a switch-mode power supply, the AV5125 doesn't need massive power transformers or heat sinks or a number of things that conventional amps would need to deliver five channels of 125 watts. The AV5125 is a cute little thing that weighs only 11 pounds!

### Performance

Unlike the Linn Klimax Solo, the AV5125 simply didn't offer enough positive performance attributes to overcome the negatives of using switch-mode power supplies. It didn't grab the speakers and control them in the exhilarating fashion its big brother did, and it was more than dark and slow—it was outright opaque with a noticeable lack of transparency with music material.

My hope had been that at the least the AV5125 would provide some dynamic thrills so that I could call it a good home theater amp, but I found it to be far less gripping in that regard than several amps costing far less from Parasound, ATI and others. The Linn AV5125 simply wasn't competitive.

The only caveat of my review is that because of the bizarre connectors used on the AV5125's back panel I was forced to use Linn's speaker wire, which looked like black tire rubber. I terminated that cable with spades and used it with my reference amps and found it to be quite dark, so some of the opacity I heard with the AV5125 could be due to that wire. But given how poorly the AV5125 fares against products costing half as

much, and its use of those peculiar connectors, I simply can't come close to recommending it based on my experiences. [APJ](#)

# *conclusion* AMP SURVEY by Shane Buettner

*I feel we did our job almost too well in selecting the amps for this issue—not a single one of the amps we chose in our feature reviews performed poorly! We're not being too easy on any of these guys. They were all good in most ways, although I have some firm preferences I want to share here.*

Two products from this survey, at opposite ends of the price spectrum, stood out to me: the Ayre V-5x and the Theta Citadels. The Ayre is a stereo amp that costs \$4,500 and challenges the state-of-the-art, cost-no object Citadels, which come in at over \$15K/pair. The Theta is better in some key respects, like top end air and bass authority and articulation, and it is overall the finest amplifier I've heard. But no one would have to make any apologies whatsoever for a system built on an Ayre V-5x. The V-5x is good enough for the highest of the high-end systems. It has image focus, musicality and resolving power to spare.

Charles Hansen deserves high praise as he created the basic circuit design for both the V-5x and Citadel and the now discontinued Theta Dreadnaught—altogether the three best amplifiers I've heard.

It's difficult to speak in absolutes, but all three of these solid-state amplifiers have two things in common with tube amps. Low or zero feedback topologies and natural, organic sound quality that's less like hi-fi and more like music. Charles Hansen would say that this is not coincidence, and after listening to the number of amps that I have I'd agree there's something to it.

The zero feedback solid-state amps have a purity and musicality about them that stands out from other solid-state designs. What we heard here are amps that have some of the addictive sonic attributes of tube amps, like the spooky holographic imaging of the Ayre V-5x and Theta Citadels for example, without the colorations or limitations of tubes (and obviously no re-tubing either). Without overstating the case, these zero feedback solid-state amps are looking more like a watershed point

in industry history.

Before moving on from the solid-state amps, this survey also shored up my already high opinion of the original Theta Dreadnaught, which stands on its own against all of these products and is embarrassed by none. No amplifier I've come across yet outperforms it to a significant degree cementing its status in my mind as a modern classic.

As for the tube amps, it's not that they weren't impressive or even excellent in most respects. Some of you will find you can't live without them and I won't begrudge you that. As natural and purely musical as the solid-state amps above are, there's still something to that old tube magic.

The ARC has some vestigial (albeit minor) tube grunge, the VTL is just a little soft and distant in perspective, and the Nagra isn't suitable for playing all types of music at satisfying levels. And none matched the extension and authority at the frequency extremes that the Theta amps showed, although the VTL MB-450s had less of these drawbacks than the others by far.

The ARC was remarkable for its vivid midrange, but the VTL MB-450s were amazingly free and effortless with shocking dynamics. Nothing I threw at the MB-450s made them sound like they had to breathe hard. They had no tube grunge, and thus a remarkable clarity about them, and the top and bottom end extension was remarkable. Still not a match for the Theta Citadels in bass articulation or top end air, but better than the other tube amps we listened to. All in all the ARC represents an excellent value in a \$6,500 stereo tube amp, and for more money the VTLs step up with performance increases of their own that are extremely impressive.

This is a good group of products. Do some listening and see if you don't agree. [APJ](#)

## *Richard Hardesty comments on the...* AMP SURVEY

*Twenty years ago tube and solid-state amplifiers would not have been as competitive on a level playing field. Things have come a long way since then. Even in 1990, nobody could have convinced me that after listening to a selection of the world's finest amplifiers I'd choose a solid-state model for myself.*



# MULTICHANNEL AMPLIFIERS?

by Richard Hardesty

*Each channel of audio amplification is a separate entity so, in theory, it makes no difference whether an amplifier is a monoblock or a multichannel device. In practice the audible differences between a single channel amplifier and a multichannel device may be insignificant or substantial.*

Three obvious differentiating factors appear with little scrutiny: cost, size and heat. The power supply is less obvious but probably even more critical to sound quality. Each channel may have its own supply, or part of one, or all channels may share a common supply.

People expect to pay less per channel for a multichannel amplifier. They expect to save space by combining all channels in a single chassis and they expect the product to be just as reliable even when driving a home theater system that will probably be played at significantly higher volume levels.

### Cost

The chassis and front panel represent significant costs to the manufacturer. Considering only these items makes a multichannel amplifier seem like a good idea. Why duplicate the costs of metalwork when one chassis and front panel will do.

The chassis will have to be bigger and heavier and much more heat sink area will be required. All the same connectors will be necessary for the inputs and outputs of each channel. A high quality multichannel amplifier could cost somewhat less but the price difference probably won't be as great as you might first imagine.

Figuring the cost per channel is easy—simply divide the total price by the number of channels. Some amplifiers can be configured with two channels and additional channels can be added. The first two will cost more because the initial cost will include the chassis and front panel.

### Size

A five-channel amplifier is likely to be smaller than five single-channel amplifiers because of the shared metalwork. Five channels will create as much total heat whether packaged in a single chassis or mounted on five separate chassis but the heat will be harder to dissipate in a single unit due to the prox-

imity of sources and the reduced amount of metalwork.

A smaller amplifier will take up less shelf space but the number of connectors will be the same and the wiring is likely to be more difficult because all the connectors and wires will be in close proximity. You'll have to use longer speaker wires and that will depreciate the sound and lighten your wallet.

### Heat

Dissipating heat can be a problem. Even if each channel has its own heat sink, they'll share heat because they're positioned tightly together and there is less metalwork to absorb and reradiate heat. A multichannel amplifier may use less shelf space but require more open space around it to provide adequate cooling. An enclosed space may require a fan.

Some multichannel amplifiers use the same circuit designs as their stereo counterparts but operate at lower bias levels to control heat. Compare bias specifications (if available) to see if you may be sacrificing sound quality due to reduced bias when identical circuits are used in multiples.

### Power Supply

Each amplifier in a multichannel design may have its own power supply and its own transformer, or a common power supply may be shared by all channels. Some designs use a common transformer and individual rectifiers and capacitors for each amplifier module. There are pros and cons to each design choice.

Separate transformers provide complete channel isolation for the best (theoretic) imaging and the lowest crosstalk between channels. Some advocate the use of separate, albeit smaller, transformers in multichannel amplifiers.

A single, larger transformer can provide more potential power to an individual channel in operating conditions where all channels aren't demanding full power at the same time. This is how things will be most if not all of the time in actual operation.

Trade-offs can provide some of the advantages of each choice. For example, a single, large transformer can be combined with individual rectifiers and capacitor banks for each channel providing some of the isolation of multitransformer designs along with the power reserves of the larger, common transformer.

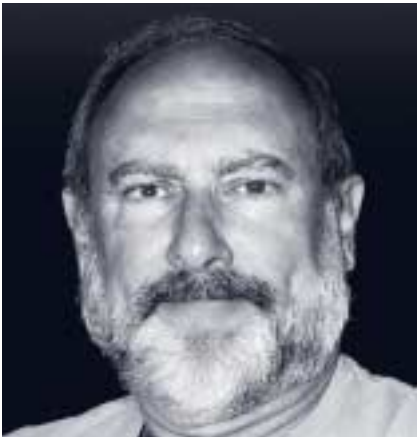
### Conclusion

A well-designed multichannel amplifier can provide near state-of-the-art sound for a stereo system and provide extra channels for vertical biamplification and surround sound use.

A system that provides an all-out assault on sound quality will probably utilize monaural amps to power the stereo speakers and a three-channel amplifier for the center and surround channels, if used. **APJ**

# AMPLIFIER ANTHOLOGY

by Richard Hardesty



*When reminiscing about amplifier development I have to admit that I built my first amplifier kits more than 50 years ago. Obviously I'm older than I feel.*

As compensation for my long involvement with electronics I got

to watch the evolution of audio amplifiers through the period when the first transistors were introduced into consumer products. I listened to amplifiers before, during and after the switch to solid-state devices.

I sold and serviced high-end amplifiers during this revolutionary change and listened to music through both tube and solid-state components for over half a decade. During that time amplifiers got much better and became less of an impediment to my involvement with music.

### My First Portable

When I was a kid, in the days of wooden ships and iron men, I carried around a Motorola portable radio that contained four vacuum tubes. It weighed about six pounds due largely to the fact that it took two enormous batteries to provide the necessary power. One of the batteries was rated at 90 volts and could produce quite a jolt, as my mother can attest. Once I spit on the terminals and touched them to the back of her arm to see what would happen. She got a shock and has never seemed quite the same!

This early "portable" radio was about 14 inches wide and nearly a foot high. It had a rotating antenna on top that doubled as a carrying handle. It was far too heavy and much too large for the journey into space, as were the bulky computers of the day. That's one of the reasons why we didn't make it into space until the transistor was invented.



### The Transistor Revolution

Transistors made it possible for us to go to the moon because they allowed us to make lighter spacecraft. They made it possible to miniaturize consumer electronic components and produce them for far less money. Transistors made it possible for everyone to have a hi fi system.

A good tube receiver cost more than a month's salary in the 1950s and a solid-state receiver with more bells and whistles sold for the equivalent of about one-third of that in the '60s. When I got into the audio business in the '70s, everybody could afford to own a respectable hi-fi system and everybody did. It was a good time for middle class Americans but not such a good time for those discerning individuals who wanted the best sound.

The first solid-state amplifiers appeared on the market in the 1960s and they sounded pretty bad. The sound was sterile and harsh but the guys who worshipped their test instruments told us that we must be deaf if we couldn't recognize their superiority. The early solid-state amplifiers were clearly more accurate, they said, because they had less distortion.

See how much better they sound? they asked as they showed us the measurements. Everything will be fine as soon as the recording engineers learn how to use this new, improved tool, they said. (This same argument popped up again when digital was introduced in the '80s, and yet again when surround sound was introduced, for the second time, in the '90s.)

I think I'll take a break now and go downstairs and listen to an analog stereo recording on vinyl played through my tube preamp.



### Japan Conquers Consumer Electronics

American companies fell by the wayside as Japanese manufacturers took over the consumer audio market

in the 1970s. Venerable American brands like Fischer, Scott and Marantz either failed or were purchased by Japanese companies. Everybody tried to jump on the transistor bandwagon.

Audio Research, who had developed an enviable reputation as a maker of fine tube gear, completely converted to transistors in the mid-1970s with the SP-4 preamp and the D-100 amplifier, both of which were completely solid-state. This proved to be financially disastrous and ARC soon resurrected their tube products, which were produced alongside the solid-state stuff then as they are today.

Tube products were available from high-end companies like ARC, Conrad-Johnson and Counterpoint but most regular folks settled for affordable solid-state components. Many audiophiles simply held on to their US-made Marantz or Harmon Kardon tube amps until the first really good solid-state amplifiers arrived in the late '80s.



### Fads

The test bench “experts” kept insisting that solid-state amplifiers were superior to tube amplifiers but discerning listeners knew better. Some of these listeners were engineers and they set about trying to discover why the early transistor amplifiers sounded bad. They could hear that the “perfect” solid-state amplifiers sounded different from one another, and many explanations were proffered to explain these differences.

We went through a series of fads that eventually proved to be more about marketing than sound. Amps were produced with ultralow distortion, “high current,” incredibly high slew rates, and amazingly broad bandwidth, but the sound didn’t get much better until the smart guys started to find reasons for what the discerning guys were hearing.



### Low Distortion

Early solid-state amps had about one-tenth as much harmonic distortion as comparable tube amps but still sounded harsh and sterile. Some thought that even less distortion was the answer. Amplifiers were made with incredibly low distortion measurements. Lots of negative feedback made the distortion measurements better and the sound worse. Walter Jung and Matti Ojala studied solid-state amplifiers in the

'70s, identified new kinds of distortion and offered these newly identified distortions as an explanation for amplifier sound. Reducing distortion caused by current-limiting or voltage sag, preventing slewing-induced distortion and minimizing transient intermodulation distortion became fashionable. Some of this actually worked.



### High Current

You can’t cause current to flow without voltage so just what is a “high current” amplifier? It’s an amplifier that can deliver the required current when the load impedance drops. Most high-end amplifiers don’t have a problem driving low impedance speakers but many mass-market amps did and still do.

In the early days it was fashionable to make cheap amplifiers with puny power supplies and high voltage rails because these amps could produce a high power rating into an 8Ω resistor, which looked good on the specification sheet. When the load impedance dropped creating a greater demand for current, either voltage would sag in the inadequate power supplies and/or current limiting would kick in preventing damage but compressing dynamic range.

Amplifiers with adequate power supplies were then advertised as “high current” amps as if some new miracle had been discovered. They cured a problem they had created while attempting to keep the specs high and the costs low.



### High Slew Rate & Broad Bandwidth

In an unfiltered amplifier, slew rate is a corollary of bandwidth. An amp that can deliver high frequencies can slew pretty fast. This too was carried to extremes until people realized that some of the best sounding amplifiers had reasonable slew rates and reasonable bandwidth. Excessive bandwidth can actually cause problems as the amplifier tries to amplify radio frequencies (RF) and other garbage along with the audio.



### Solid-State Comes Around

The tube amplifiers I built in the 1950s sounded a lot like the tube amplifiers of today. The solid-state amplifiers that dominated for the next thirty years certainly didn’t sound like today’s best solid-state amps. Towards the late '80s the sounds started to converge.

## Amplifier Anthology

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Tube amplifiers got better and more reliable thanks to the development of superior parts. Tube amplifiers still provided the most musical sound and delivered far more dynamic contrast than solid-state amps with similar power ratings. They were deficient at the frequency extremes and usually exhibited rolled-off highs and softer, sometimes bloated bass. Tube amplifiers always had higher noise levels and still do.

In the 1980s the best solid-state amplifiers ceased to be harsh and generally provided a more musical sound than their solid-state predecessors. Backgrounds were quieter and bass was tighter with more punch than tube amps could deliver. The best solid-state designs were often more open on top with a lighter and airier sound but the best tube amps still presented more harmonic detail and a richer, more lifelike midrange. Tube amps always won the imaging battles.



### Trade-offs?

Twenty years ago there was a clear trade-off between tube and solid-state amplifiers. Tube aficionados sneered at solid-state heathens who had yet to see the glowing light. Solid-state guys snickered at tube fans

because they preferred “coloration” over “accuracy.” Things have changed. Let me tell you about our recent adventure.

For this **Journal** we assembled a collection of the best amplifiers we could find and listened to them in head-to-head comparisons in the same room with the same reference components. Things didn't turn out as I expected. The clear-cut trade-offs of the past were blurred or nonexistent.

We'd collected a group of outstanding amplifiers. There is no question that I could make great sound with any of them and truly excellent sound with all but a few. I was really surprised to find that the amplifiers I liked the best were completely solid-state. Following these comparisons, I ordered a pair of Theta Citadels because they were the best sounding amplifiers I had ever heard. I didn't feel that I had to compromise at all.

I'll bet that you can get just what you want in an amplifier today. You won't have to settle for inferior performance in one area to get superior performance in another. Go listen to today's best amplifiers and hear for yourself. [APJ](#)

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