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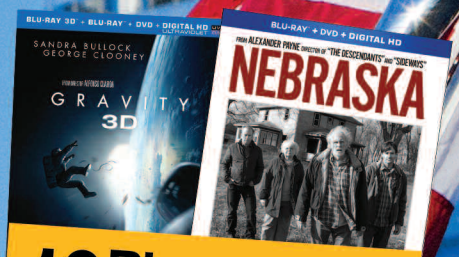

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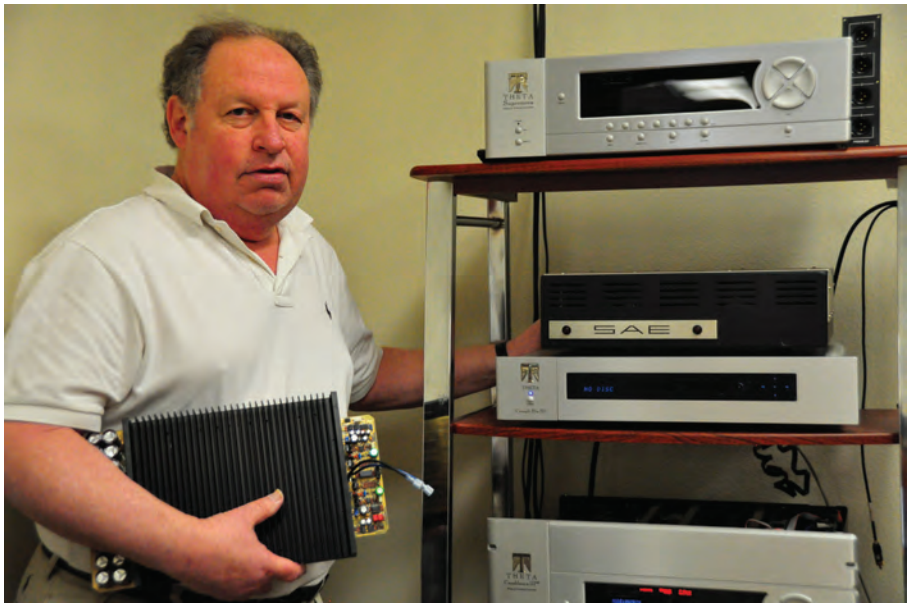
Amplifier Technologies Incorporated

"American Muscle"

Gary Reber



Morris Kessler with first SAE amplifier and newest Series 6000 module under arm

This is the second On Screen interview with the creative electronics designers at Audio Technologies Inc. (ATI), who also design and manufacture Theta Digital products. The first On Screen interview appeared in Issue 184, February 2014 with Founder Morris Kessler, Design Engineer David Reich, and Marketing Director Jeff Hipps.

Gary Reber, *Widescreen Review*: I'm here at ATI, Amplifier Technologies, Inc. with Morris Kessler, who's the founder, and Dave Reich and Jeff Hipps, sitting together in the company's intimate sound room. The subject of this interview is the leading-edge design work of founder Morris Kessler. What caught my eye recently is a communiqué I received from Jeff Hipps, and it had as part of the ATI logo the phrase "American Muscle." I thought that was great description of ATI. Why did you choose that phrase?

Jeff Hipps: I had just started with Morris. It was my third day working for him after having run a high-volume receiver company in the U.S. for 15 years. I was in our suite at CES unpacking these mammoth things that he builds. I finally get everything unpacked, and I open up the banner for ATI that we're going to use to talk about his company, and under the picture of this huge, 130-pound, seven-channel amplifier, it said "Translating Technology." In my mind I said, "This isn't about technology, this is American Iron." And as I thought about that phrase, I really liked the way it described what we did, but I thought, "No, 'American Iron' is really too specific. This is 'American Muscle;' this is the skill to build it; this is the know how to do it; this is the ability to design it; this is our ultimate product." "American Muscle" perfectly complements what we do and is now our marketing slogan for Amplifier Technologies.

***WSR* Reber:** That's great. I like it. I think you should stick with it. Morris, when you and I were growing up, it was an age of vacuum tube amplification—mono amplifiers and the first stereo amplifiers. I built Eico and Dynaco kits and I built Heath kits when I was a kid, so it's interesting to me that prior to founding ATI, your first amplifier was a modular solid-state design, and in 1967 you co-founded SAE. So, why solid-state?

Morris Kessler: Well, first of all, I did build tube amplifiers. In the old days all Dynaco kits were tubes. Anyway, I've always played with electronics, or electricity, if you will, and I had a semi-relative who wanted to put one of those new-fangled stereo systems in his house in 1959. So he grabbed me, I was 14 at the time, almost 15, and we went down to Melrose Avenue in LA, which was Hi-Fi row at the time. There were maybe five or six hi-fi stores within four or five blocks, and we ended up at Hi Fi Corner. He purchased this tremendous stereo system for about $800, with a Fisher receiver, a Garrard turntable, and a bunch of JBL loudspeakers to be built into the walls and ceilings. Then he says to the owner of the store, "My nephew here needs a summer job when he graduates from Junior High." And of course the owner said, "Sure, no problem." I was ecstatic. This was in March of 1959, and I went and I put this stereo system in his new house. And the first day after graduation—I graduated on Friday—and on Saturday morning I went down to Hi Fi Corner and walked into the store and said, "Here I am ready to go to work." And the owner said, basically, "Who the hell are you? I don't remember you." "Don't you remember? I was here three months ago with so and so, and you said you'd give me a summer job." He said, "Oh, okay." And my very first job in hi-fi was bagging records. In those days most hi-fi stores had a little record department. And the records were not sealed. That was before they figured out that they better seal them because people would take them out and swap them around.

Hi Fi Corner had their own hot-wire bagging machine. So my first day in audio was putting records in plastic bags. I worked there after school and summers for several years. Solid State was just starting to come around and most solid-state designs used germanium transistors—the first Fisher receivers, the first Scott receivers were all germanium. They sounded terrible and they were even less reliable than the way they sounded.

Then a couple, three guys in Massachusetts from MIT led by Morley Kahn started a company called Acoustech. Do you remember Acoustech? I'm not sure you do because they lasted from 1960 through maybe '63 or '64. Acoustech was the first company that I know of that actually made amplifiers with silicon transistors. The first high-quality, reasonable-cost silicon power transistor was an RCA 3055. So they started making amplifiers. They actually made a set of powered electrostatic loudspeakers, like the KLH9's, except with the amplifier built in.

Hi Fi Corner started selling Acoustech amplifiers and I just loved them. They were the first solid-state amplifier that actually could give a tube amplifier a run for its money. But they also weren't all that reliable. I was selling audio at this point, and I would sell an Acoustech amplifier to someone, and I felt really bad when the amp failed so I started learning how to fix them. I started seeing the weaknesses in the amplifier and beefed them up so the fault wouldn't happen again. Pretty soon I knew how the amp ticked. And by 1962 I decided, I'm going to build my own amplifier from scratch, and that's the unit you see up front. I basically said, I'm not going to build a kit, or someone else's design, I'm going to design and build my own amplifier. After I built that amplifier, I built a few of the handmade, one-off kind of things and improved them slightly, extending what Acoustech had done. So that first amplifier you see there is built basically with military surplus parts. It's all hand-wired, with boards that actually plug in.

***WSR* Reber:** What a classic.

Kessler: That amplifier is 50 years old, 51 years old. It's crazy when I think about it because I remember building it.

***WSR* Reber:** How many watts does that put out?

Kessler: It depends on what day of the week it is. It's roughly about 20, 25, in that range. It was a single power supply with output coupling capacitors, which is what you see on the bottom. That was the main filter on top and on the bottom were the two coupling capacitors, a pair of 3055's. Actually, this unit was built before the 3055 existed, and it was a computer—some of the transistors have been replaced because they've blown up over the years, when I was actually using it. But that's a silicon stereo power amplifier. Anyway, this is the very first one, and then I started building a few with hand-built circuit boards where I actually hand-taped and etched the circuit boards—you know etch your own circuit boards in a chemical bath and then drill the holes for the pads...it's crazy.

I worked at Hi Fi Corner till 1964—that store closed, the owner died and we started a new store in Beverly Hills called The Sound Center. Did you know The Sound Center in Beverly Hills?

***WSR* Reber:** I don't remember that one. I used to frequent Jonas Miller's.

Kessler: Jonas Miller on Wilshire.

***WSR* Reber:** Yeah.

Dave Reich: That's where Neil Sinclair [Theta Digital] got his start, by the way.

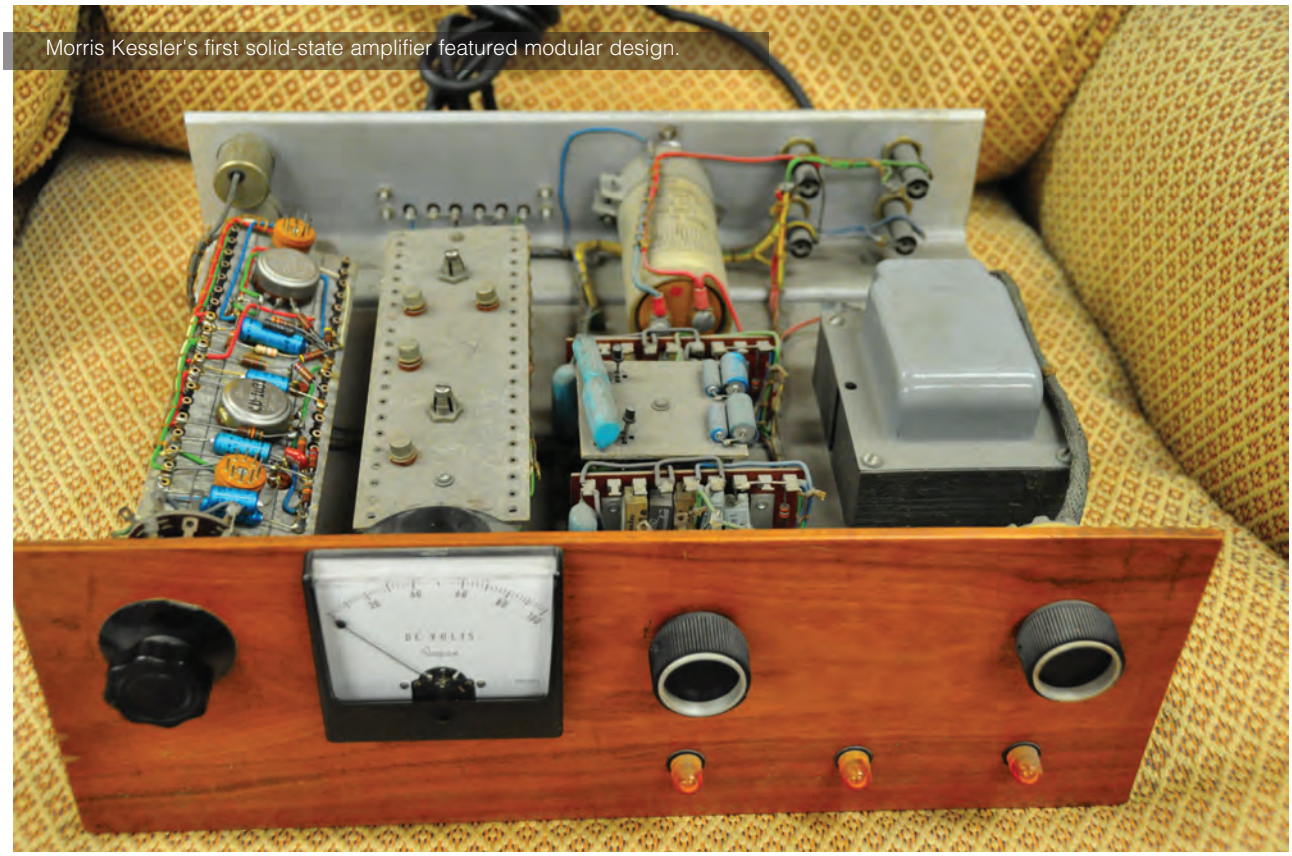
***WSR* Reber:** Yeah, it was, that's right. And Ken Kreisel. Ken and Jonas founded M&K. I became friends with Ken.

Kessler: Well, the M in M&K was Miller. Sound Center was actually not far from Jonas Miller on South Beverly Drive, and it was there for 20 years, from 1965 to 1985. I had to make a living and making and selling a handful of amplifiers wasn't a living so I went with both of the other guys from Hi Fi Corner to The Sound Center. I worked there selling and I started building amplifiers and selling them to a few of our customers on the side. Those customers went to different stores and mentioned the amplifier. Then one day I got calls from Henry Radio and High-Fidelity House. Did you know High-Fidelity House in Pasadena?

***WSR* Reber:** Yeah.

Kessler: High-Fidelity House was the high-end audio store in Southern California, period. They had heard about my amplifiers and wanted to offer them and I said, "Well, they don't really exist as a commercial product."

But there was a customer at The Sound Center—I didn't have the money to found a company, I was barely paying my apartment rent. Anyway, there was a customer at The Sound Center who said, "If I put in the money and you put in the products and the designs, we could start a company." And we started SAE. We had three dealers: The Sound Center in Beverly Hills; Henry Radio, which actually had two stores; and High-Fidelity House. Soon we were selling amplifiers in some quantity, and we were getting somewhat of a name.



Morris Kessler's first solid-state amplifier featured modular design.

The next thing we had to do, of course, was create a preamp because you can't just have an amplifier by itself. We started doing that and then the financial partner started fading away as far as participating. I was able to borrow some money and buy him out. After that, SAE grew quite substantially, and by the late '70s, early '80s, it was one of the largest high-end brands in the world. We were consistently rated one, two, or three in the hi-fi magazines' product rankings. And I had a lot of interesting engineers who worked for SAE over that period of time.

The third product that we had to have, of course, was an FM tuner. And I had all these ideas—the Marantz 10B had just come out, which was a beautiful machine—and was all tube. Obviously, I wanted to have a solid-state tuner. Our distributor at the time was also the distributor for Sherwood, and Sherwood's chief engineer, Ed Miller, was the expert, in my opinion, of FM radio at the time. Our international distributor recommended that I talk to him about doing an FM tuner. I had this great idea that I first saw in an elevator, I saw these things called Nixie tubes, and they were reading out the elevator floors as you went up and down. And I said, "Could we put these on the front of a radio and actually read the frequency?" And I had a couple of conversations with Ed Miller before he finally came back and said that he wasn't interested in helping me with an FM tuner. That was 1969. So I sort of forgot about it for a while, and then I found out from our distributor that Ed Miller sold his interest in Sherwood and was moving to LA. And I said, "Oh, wow, I'll call him again and see if he's interested." And I called him again and said, "I have all these ideas that we've talked about in the tuner project"—little known to me, though, that Sherwood had actually started designing a Nixie tube FM tuner, and I'm sure it was based on my original conversation with Ed. Be that what it may, Ed Miller turned me down again because he was semi-retiring to Southern California and had purchased a car wash, of all things. Anyway, a few weeks later he changed his mind and he decided to come work with me on an FM tuner and we created the SA Mark VI tuner, which really was the first digital read-out FM tuner in the world—even though Sherwood claims they were first, but their tuner came out later, six months to a year later than the SAE. We actually beat it. Ed Miller had figured out how to make a frequency counter read the actual frequency. It's actually pretty simple, but it took someone like him to figure it out.

So we had the VI and the VI B FM tuner and we had a preamp and we had an amplifier. And from there SAE really started to take off and created quite a name for itself. Ed Miller worked for me. He actually was the head engineer for several years. And then in 1973 he came to me and said he was getting older, "I'm going to retire again, but I'm not going to leave you in the lurch. I've found an engineer to replace me." "Okay, who is it?" "It's James Bongiorno." Do you know James? So in 1973 I hired Jim Bongiorno to be our head engineer and Ed Miller, of course, changed his mind again and decided to stay, so I had two head engineers, which actually worked out pretty well at the time because Jim was mostly an amplifier person and Ed was more of an RF-type person, although Ed knew a lot about amplifiers also. Between the two of them and what I threw into the mix, we created a lot of nice equipment.

Jim broke off and started his own company called Great American Sound and went on his way and I went on my way. SAE grew, and in the late '70s, early '80s, had quite a high market share. We built a new factory on a piece of property we owned in downtown LA that the city of Los Angeles later forced us to sell via "eminent domain" for the subway. That kind of turned the whole company upside down and I decided to sell the company to Giorgio Moroder. Do you know who he is?

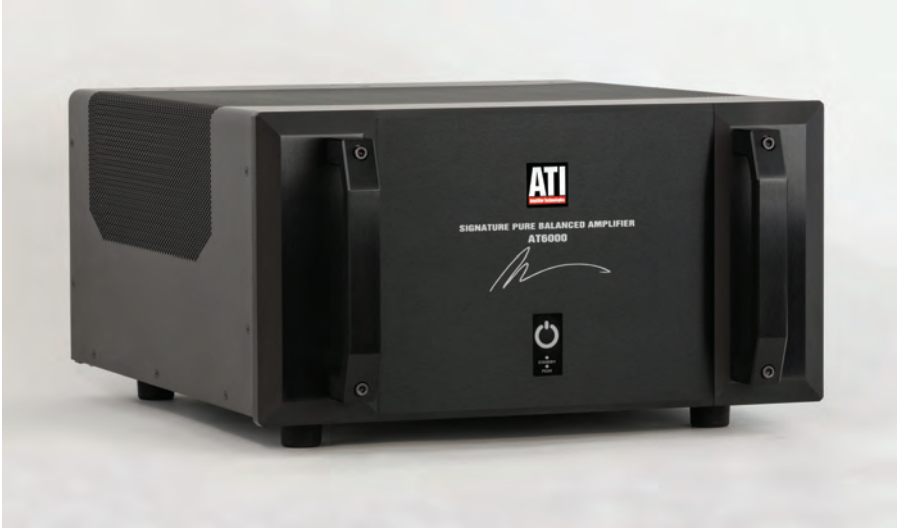
***WSR* Reber:** Yep.

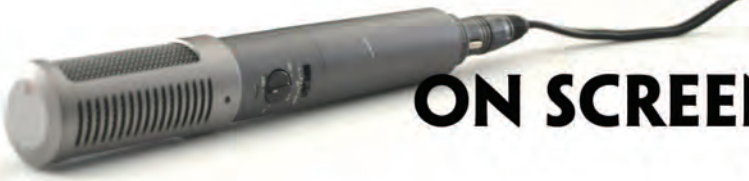
Kessler: Giorgio Moroder at that time was flying high with disco music and Donna Summer and making 30, 40, 50-million dollars a year and was using SAE equipment. I had a lawyer friend who had done some work for him and he said, "Moroder would love to buy your company." And I said, "Well, he doesn't know anything about it but he's welcome to buy it if he wants it." It was kind of ironic because the owner of Sherwood at that time was a Korean company called Inkel. They also wanted to buy SAE but they were doing it the typical Korean way, which means dragging it out and wearing you down, and Moroder just said, "Tell me how much and I'll write a check." So we told him how much and he wrote a check and Inkel said, "What happened?" But anyway, Moroder bought the company really on a whim and owned it for about 10 months and then he sold it to Drew Kaplan at DAK. Do you remember the DAK catalog company?

***WSR* Reber:** Yeah.

Kessler: DAK could have been Amazon.com if they hadn't screwed up. DAK owned about 25 different brands but was taken over by their bank. Nine years later I was able to buy the SAE name back. It's kind of ironic. It's not often you get a chance to buy your own company back. And I was kind of retired during that period, after I sold SAE, which was 1989, till about 1993.

A draftsman that worked for me at SAE contacted me one day and he told me about this new Apple computer system and how you can design things on it. It even had a rudimentary CAD program, and all this kind of stuff. I said, "That's nice." And I went out one Saturday to visit him and he showed me this big monitor that you couldn't even lift and a Mac 3C, or something like that, which was their higher-end Mac, and how versatile it was. Using it you could lay out circuit boards and do mechanical drawings all by yourself, you didn't need to sit there with a pencil and paper. And I said, "Wow, that's pretty cool." So I went out and I spent about $8,000 and bought a whole Mac system, and I really didn't have any real idea what I was going to do with it, but I started playing with it, which obviously millions of people did, learning how to use a desktop computer. I came to the realization that the only thing I know how to design are amplifiers. So I decided to design an amplifier completely on a Mac computer, from one end to the other, the circuit boards, the artwork, everything. And I did this, and I built a two-channel





amplifier with bits and pieces, and I built about 10 of them in 1993.

It was a nice amp with good specs and 300 watts per channel. I took it to CES in January of '93 actually. And I got a room at the Hilton Hotel and sort of walked around the show and basically said, "Come see my amplifier" to anybody that would listen to me. I even had a brand name—ATI—Amplifier Technologies. I invited a few people up to the hotel room to see this amplifier and so on, and one of the people was Newton Chanin, the head of Adcom. Did you know Newt Chanin?

***WSR* Reber:** No.

Kessler: Newt had been a well-known sales rep on the east coast. His company, Audio Associates, still exists but with different ownership, and he owned Adcom. So I showed Newt and his Adcom associates the amplifier I had designed. Adcom was a good brand name but was never really a manufacturer, everything they had was made for them, and they looked at this amplifier and said, "Very nice, but if you want to make amplifiers, why don't you make an amplifier for us? Then from the get-go you could be making hundreds or even thousands of them." So they offered a way to hit the ground running, as they say. Instead of trying to make five amplifiers and find five customers, which could take six months, I could be building hundreds, if not thousands of amplifiers from the beginning.

But they said to me, you know, you've been gone from the audio industry about four years, and something was just starting to happen. They said they didn't want a stereo amplifier, they wanted a five-channel amplifier for surround sound. I said, "Surround sound? What's surround sound? You mean, there's more than two loudspeakers in a room and you need more than two channels?" I guess up to that time there were no five-channel amplifiers. There were a few three-channels that people were making to put with an existing two-channel amp to create a five-channel system. But people wanted it all in one box.

One thing about amplifiers that's kind of interesting—it's why people like mono blocks. When you start putting multiple channels in one box, they start to talk to each other. They start to interfere with each other. One channel can cause noise in another channel. Obviously, crosstalk is an issue. In a stereo amplifier it's not too bad. You put one channel way over on the left and the other way over on the right and you put as large a gap as possible between them. So when they told me they wanted five channels, I put five channels in an amplifier and it was a disaster. They were all talking to each other. They were all making noises to each other. They were all buzzing differently, and if you turned one channel on, another one buzzed. And if you turned that one off the next one buzzed. I learned that you just can't take channels and put them right on top of one another.

The first amplifier I did for Adcom, which as far as I know was the world's first five-channel, all-in-one chassis, was the GFA-6000. It was, by our standards, wildly successful. We made a couple of thousand a year for several years. And it performed okay. I got the inter-channel chatter down so it was at least acceptable but I started trying to figure out how can I make an amplifier channel that wouldn't talk to, or at least minimize the amount of talk to other channels. And I basically came up with an all-in-one solution, where the power supply and all of the amplifier circuitry is on a single circuit board. Essentially there are no wires., Everything is on one board so it's all predictable. This (holding an amplifier channel), is an extreme version because this is a fully balanced channel, but the original version was a simplified version of this. Once you got it like this and you put one channel right next to it and you figured out the pattern of the circuitry so it wouldn't talk to, or at least minimized the crosstalk and cross interference, I was able to start getting five and seven and all the way up to 16 channels in one box, which I did for Crestron, with virtually little or no crosstalk or cross distortion or cross noise. And that was the trick of getting multiple-channel amplifiers built.

***WSR* Reber:** So the Adcom was the first one.

Kessler: The Adcom 6000 was the first five-channel amplifier and the first one that ATI as a company built before it built any of its own amplifiers.

***WSR* Reber:** Did you build the Crestron next?

Kessler: Crestron was later.

***WSR* Reber:** After ATI had already introduced its own line.

Kessler: Yes, what happened with my arrangement with Adcom was, okay, obviously I want to do this amplifier for you but I'm not killing ATI. In other words, once we get that established. So the Adcom 6000 was actually the first product that ATI built. And then, of course, they wanted me to do other amplifiers, with one caveat. They wanted Nelson Pass to design them. And I said, "Okay." Nelson Pass is into Mosfets and Fets and very simple circuitry. That part was nice, very simple, straightforward circuitry, not over-designed. The problem with Nelson Pass' designs, if you want to call it a problem, first of all I got all the schematics on a napkin. It was very informal, number one. And the other thing is that his stuff, as good as it is, it's quite good, but it's really not designed for mass manufacturing. You have to sit there and tweak each one, not dissimilarly from the Theta.

One of the things, just backtracking a little bit, when you're going to build multichannel amplifiers with five and seven and 16 channels, you can't sit there and tweak them all. They all have to be basically put together with minimal or zero adjustments and turn them on and they're all perfect. You can turn our current designs on one after another, just adjust the bias real quickly and you're done, and everything else is stable, perfectly stable. You have to resolve that because you just can't make that many channels and sit there and play with them, as we do with Theta. It doesn't make it a better or worse amplifier, it just makes it more viable for production. For a simple number, we built over 560,000 channels of the Crestron amplifier. At that volume, they can't be hand-built.

So the combination of resolving the interference from channels and being able to create channels that are as close to perfect as possible without having to play with them, and that's gotten to a point of sophistication with this latest version.

***WSR* Reber:** I want to go back to what I consider a very important question, what you didn't address. Why solid-state over tube?

Kessler: Well that's a good question, I guess. The obvious thing is you certainly couldn't make a 16-channel tube amplifier.

Jeff Hipps: It would be the size of this room, number one, and efficiency wise...

***WSR* Reber:** I was thinking in terms of performance quality and fidelity. Is there a difference?

Kessler: Oh, there's a tremendous difference. You can get much lower tested distortion—measured distortion—on a distortion analyzer, out of a solid-state amplifier. Tubes have reached their limit. They're not going to get any better. The interesting thing about tubes is that their distortion is highly even-order harmonic distortion. That's why a lot of people like tubes because they're very warm sounding. Well, warm sounding means that they have a lot of harmonics, even-order harmonics. Every instrument, every room, everything, a piano or a violin, the harmonics are part of the instrument. The question is, do you want to add more than the instrument? Some people like that and that's fine, where a tube amplifier actually takes the instrument and makes it even more melodic, if you will. So a lot of people didn't like solid-state amplifiers from the beginning because they sounded too real, which is kind of a weird statement. And of course, the solid-state amplifiers have come a long way, where they need not have the harshness and distortion that you relate to early transistors and amplifiers.

I mean that thing (pointing to his first amplifier) played music, the old one sitting there, but it certainly wasn't a great-sounding amplifier. It took awhile for solid-state amplifiers to really surpass tubes; there was an overlap. A good tube amplifier sounded better than a bad solid-state amplifier. Amplifiers were actually pretty bad through about the mid '70s, when we discovered how to use feedback properly, and also that feedback could cause sonic distortions that people didn't like if used improperly. Then some engineers came up with this great idea that if feedback can cause a distortion that people don't like, we'll just get rid of feedback, so they created a new distortion. That's a whole long...

***WSR* Reber:** Before we go in that direction I want to come back to one other thing to close the loop. So we have Adcom and we have Crestron, but ATI has built numerous amplifiers for other OEM clients. What are some of those clients?

Kessler: Well, some I can mention, some that I shouldn't mention. The latest one, of course, is Datasat. We build their amplifiers. They were built to be the cream of the crop, they're very, very good. We have built a lot of amplifiers for Crestron, their whole audio line was developed by us for about 12 or 13 years.

***WSR* Reber:** Morris, are these amplifier designs your designs or collaborative designs, or designs by other people?

Kessler: Going back to '73, Jim Bongiorno, when he started working for me, introduced me to complimentary power transistors from Motorola, dual differential inputs, all kinds of circuitry ideas. He was very creative from that standpoint, no question. A lot of those ideas, if not most of his ideas, were developed at SAE. And when he left...

Hipps: If he developed it while he worked for you, then by law they were yours.

Kessler: Well, they were more than ours because we were building his designs, basically, at that time. After he left I spent a lot of time evolving those designs and proving them and making them better. Transistors were changing. To this day, semi-conductors change. That's a whole other story too. So the basic modern...when we went from that kind of single-ended amplifier to the fully balanced, the fully differential that was done in the early '70s, to the mid '70s, at SAE. And then it's just evolved from there. Circuitry improves with components that become available. The protection circuits are so much better than they were. You have to have protection circuitry, otherwise you can blow the amplifier up. The ones we use now are all optically coupled so the protection cannot interfere with the sound.

***WSR* Reber:** A basic question; what is an amplifier and its function in audio reproduction.

Kessler: Well, simply, the amplifier is the engine. It drives the loudspeaker. Everything before the amplifiers is all low-level, low-signal, very weak voltages. To drive a loudspeaker, which is essentially an electric motor, you need, depending on the size of the loudspeaker, you need a certain amount of high current and high voltage and combinations of the two. The amplifier takes that weak signal, a power amplifier we're talking about, takes the very weak signal from the preamp and it amplifies it both in gain to some extent. It doesn't have to, but you need some gain, usually around 20 to 30 dB, and also has a zero-gain power stage, and that's the key to driving a loudspeaker because a loudspeaker's the one thing that's totally different from an electric motor. In an electric motor you turn it on and it runs at one speed and it just sort of stays there. A loudspeaker is running at, from a slow speed to a high speed, at 20 to 20,000 different frequencies instead of just a 60-cycle electric motor. So it's a lot harder to drive a loudspeaker than a normal motor, if you will. So the amplifier affects that tremendously based on its capabilities to drive that loudspeaker. I've worked very hard to have an output stage and power supply that can deliver the current delivered into low impedances, delivered continuously, and I think the ATI amplifiers that we build for ourselves and obviously other customers do that better than any other amplifier around, as far as driving difficult loads. So that's the key and that's what an amplifier does.

***WSR* Reber:** One of the major things that separate the many power amplifier designs is the class type. What are your views on the most accurate class type? There's A, there's AB, there's D.

Kessler: And then there are a few made-up ones.

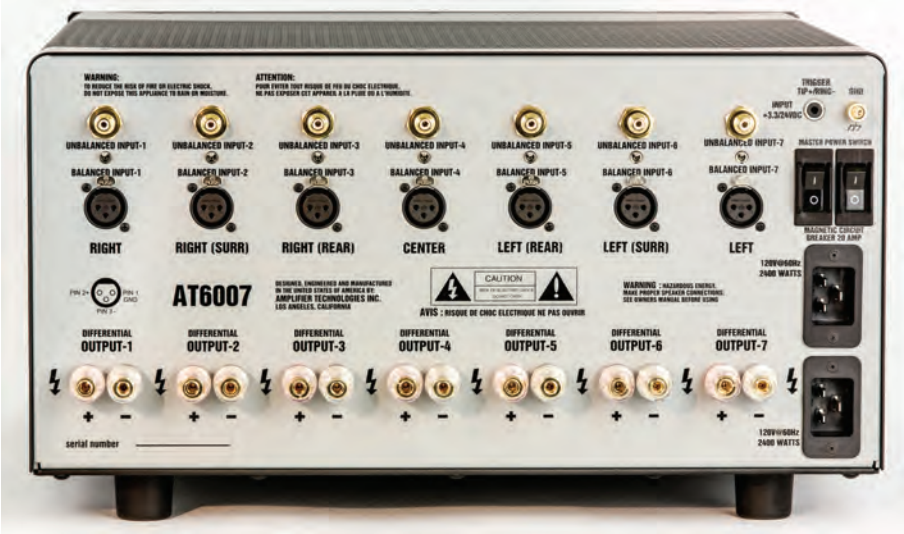
***WSR* Reber:** Yeah, H or...

Kessler: Yeah, Class H and Class G.

***WSR* Reber:** What are all these differences? What does that all mean?

Kessler: What it means, first of all, my theory about classes of amplifiers, all of them are valuable. Pretty much all of them. The question is application—meaning that there's really applications for almost all of these different classes. Where you get into a problem with amplifiers is trying to use a topology or a class of amplifier where it shouldn't really be used, or it's overlapping where other types of amplifiers could do better. A Class A amplifier is the purest form of amplification, no question about it. And if you only need a 5- or 10-watt amplifier and don't care about burning 50 or 60 watts of electricity to do it, or more, a Class A amplifier is going to give you the purest sound, bar none. But for practical purposes, where you need 100 or 200 watts, or 300 watts, a Class A amplifier quickly loses its ability to be practical, so that's what Class B... A Class A amplifier means that one device and one voltage is amplifying both halves of the signal, meaning that an audio signal is a positive waveform and a negative waveform. So to do it in Class A you have to bias the amplifier tube or transistor normally to half of its voltage, which means it's running at dissipating half its capable power even if it's not even playing. And then the signal, basically, to get the negative half is still in the positive form. So you're not crossing through anything. The signal never switches.

So Class B was invented. Class B basically said, why don't we use one device for amplifying the positive half and one device for amplifying the negative half and that way it would be a lot more efficient. It goes from 10 or 12 percent efficiency to at least 50 to 60, mid 60s, and that's a huge improvement. But Class B had a problem. You're switching



from the positive to the negative half cycle, and you're going through zero, and any kind of amplification device, whether it be a tube or a semi-conductor, when it gets near zero it distorts. It's kind of like starting your car from a red light. If you want to get from zero to 50, it's going to take a curve, and once you get to 50, then it's linear because you're staying at 50. Well, every time the transistors or tubes went through zero, you've got a point where it's switching off and then the other one's switching on and you get this little "whoop dee doo."

Hipps: That's the technical term for it, right?

Kessler: A "whoop dee doo." Crossover distortion is the technical term for it. The solution to that, of course, was to mix in a little Class A with the Class B, and you get Class AB. And Class AB was a big improvement because you could get through the crossover distortion area and improve it 90+ percent. You couldn't quite get rid of it, but you could get it so close that it was indistinguishable. Another thing that's happened, especially in solid state, is that transistors have improved greatly, where the crossover points have gotten smaller and smaller and smaller. The crossover distortion, and because of that the biasing that's required of Class A, has gotten smaller, which has made the amplifier more efficient—a little bit, but more efficient. Class AB amplifiers have been pretty much the ruling amplifier for the last 50 years because of their performance, because it's still a lot smaller than, of course, a tube amplifier, it still puts out a lot less heat than a tube amplifier, and so on.

And now you've got Class C, which is basically a radio transmitter amplifier. That's not considered part of the audio world. What else? A Class D. Class D doesn't stand for digital, it just happened to be the next letter.

Hipps: I think it stands for Denmark, that's where they all come from.

Kessler: Yeah, you're probably right.

***WSR* Reber:** There are a lot of Class D's spec'd into subwoofers.

Kessler: Yes, well, because switching amplifiers work better at low frequencies.

***WSR* Reber:** So it's a switching amplifier?

Kessler: Yes. The word "digital" applied to a power amplifier is an oxymoron, they're not digital. There are no ones and zeros in any of these amplifiers. All they're doing is basically modulating a switching power supply. Efficiency of electronics increases with frequency. What that means is that we're stuck with 60-cycle lights. If they would make our power supply operate at 400 Hz, all the electric motors would get smaller, all the transformers would get smaller, everything would get better, but when they invented alternating current they decided 60 Hz was just enough, the flickering stopped, or at least looked like it stopped, and they said that was enough. They weren't thinking about transformers and motors and all that kind of stuff. The switching amplifier, basically is an analog amplifier, where you're switching the output transistors, in most cases MOSFETs, because they're very high frequency, at a very high frequency, and you're modulating the signal in one form, there are different ways of modulating it, on top of this high frequency. The major problem with switching amplifiers is when you convert it back to an analog signal they haven't yet figured that out. It kind of makes me laugh because they talk about the analog sunset, well, if there's an analog sunset, we better learn to talk in ones and zeros and hear in ones and zeros because we're not going to be able to hear or talk or anything if analog goes away completely. You still have to convert the signal back to an analog signal at the end. No matter what, the loudspeaker doesn't play ones and zeros. And when they do that, you have to filter out the high frequencies. That's why I said, the earlier, slower switching amplifiers were not bad for subwoofers. You can get a lot of power out at a high efficiency, at least in the 80s, 80 percent, some claim even into the 90s, although the sound quality gets worse with the higher frequency. You have to get rid of this carrier frequency, which could be 200, 300, 400 kilohertz, and it's not easy to do. To filter it out completely requires a passive component that could be as large as a Class AB amplifier, to do it properly, or at least to do it to a competitive state.

I personally think that switching amplifiers have their place. If you need an amplifier to take to a rock concert and you want to schlep them around or hang them from rafters, there's an advantage of having a 20- or 30-pound amplifier compared to a 100-pound amplifier, and you're willing to give up some sound quality, and so on. But for a high-end audiophile system with really good-quality loudspeakers, and all the rest of it, a switching amplifier is going to be hard pressed to beat a well-designed Class AB amplifier. I don't think it's possible. Correct me if you disagree.

***WSR* Reber:** But isn't your company, Theta Digital, introducing a switching amplifier?

Kessler: Yes. The answer is yes. It is also the closest thing to a Class AB amplifier that we were able to find. It's actually what's called a free-running switching amplifier. It doesn't have a modulator. It still does have a carrier frequency that has to be filtered out, and it has some value in that sense. It does still use a linear power supply, it's just a switching output stage, and it's analog all the way through, up to the output stage. And that's for Theta. Theta lives in that world. How should I say this politically? I still don't think it'll be the sound quality of the 6000, the ATI 6000, or the analog amplifiers that we do, but it's close. Has close ever been good enough in the high-end audio world, by the way?

Hipps: Of course.

Kessler: Yes?

Hipps: The reason close is good enough is because you have people who make emotional investments in certain design camps. And they simply tune out any evidence to the contrary.

Kessler: Well, let's not go into other people's philosophy.

***WSR* Reber:** Well, let me give it from this perspective. I have three reference systems in my home, and my main reference system is using ten channels of Classé, 300 watts, 8 ohms. What's interesting about this is that my electric bill, for a few years I just let them stay in standby mode, and my electric bill was humongous. My wife keeps complaining about our electrical bills, so I finally decided, with my Equi=Tech balanced-power, 30-amp electrical system, there's a power switch on it.

Hipps: Yeah, you could turn it off.

***WSR* Reber:** So what I do now is I only turn my system on when I'm going to do a review. I actually turn the whole thing off from the source and everything is shut down. And my power bill just dropped, like more than 50 percent, just by doing that simple thing, turning off the juice to the system. So does the Class D use as much electricity as the Class A designs, which are always on, even in the standby mode?

Kessler: That's an interesting question. Depending on the Class D, their standby power when they're on is not that much lower than a standard amplifier, I don't think.

Hipps: But aren't we now designing standby stuff at a half-watt standby?

Kessler: Well, there are different standbys. Leaving the amplifier fully on is different than turning an amplifier off but being ready to be turned on.

Hipps: I think an AT3007 dissipates 150 watts a channel when it's idling. And in standby we can get that below a half a watt.

Kessler: There's no reason not, in spite of what some people think, that it takes four hours for the amplifier to stabilize and so on, especially newer amplifiers. This thing takes a few seconds, literally a few seconds. We can measure this amplifier within a minute, let's say, half a minute, of turning it on, and its specs are stabilized. They're not going to change. The bias isn't going to get...

Hipps: Is that partially because of the thermal trak transistors?

Kessler: It's partially because of the ther-

mal traks, partially because of the whole design. This thing about warming up your amplifier, breaking in, electrolytic capacitors are about the only thing that actually really does break in. You don't break in semi-conductors. You don't break in resistors. You don't really break in any kind of capacitor except electrolytics. Correct me if I'm wrong or if you disagree with me.

Breaking in amplifiers is kind of silly. Leaving them on is even more silly. You can turn this thing off, turn it on, and within, arguably, 30 seconds you're going to get as good a sound as you're going to get out of it. Maybe you have a 20- or 30-second window.

***WSR* Reber:** I'm referring not to just turning off the power switch on the power amplifier, I'm talking about turning off the electricity that even gets to the power amplifier. That saved a lot of money.

Kessler: Okay, then, back to Jeff's statement. When you turn our amplifier off from the front switch, it's drawing between, about a half a watt continuously, and that's actually a new, relatively new, mostly in Europe, safety requirement.

***WSR* Reber:** Is that low by comparative standards to other amplifiers?

Hipps: Yes

***WSR* Reber:** Wait a minute, all these amps on the market are what?

Hipps: Maybe they're lowering the bias somewhat, but they're still drawing a lot of power out of the wall.

Kessler: You have different things that are drawing power. You have the power supply by itself draws some amount of power in the conversion from AC to DC, and then in the amplifier channels, depending on how many amplifier channels you have, you have the biasing, the Class A part of it. Even though it's small, it's still there, and if you're talking about seven-channel amplifiers you're talking about seven times the bias, and in the case of a balanced amplifier, you're talking about 14 times, because this has two output stages.

When an ATI amplifier goes into standby it reduces down to a half a watt.

***WSR* Reber:** So that's significant.

Kessler: Oh, yeah.

***WSR* Reber:** That's a significant savings in electricity for the customer.

Kessler: Now that's one of the other arguments that needs to be discussed. Class D amplifiers are always saying, "Oh, you'll save all this money in your electricity," which is really insignificant because when you're actually using the two amplifiers side by side, the same amount of time, from the time you turned it on to the time you turned it off, and the duty cycle of an amplifier, which is like 10 percent, 1/8th now is considered the average duty. An amplifier runs at 1/8th its power 99.9 percent of the time. If you actually compare the two from a power standpoint, its pennies, to run a switching amplifier versus a Class AB. Your savings is negligible.

***WSR* Reber:** Isn't that partially because they rate Class D amplifiers as most efficient at full output?

Kessler: Well that's true of both amplifiers. All amplifiers are more efficient at full output, yes. But switching amplifiers can draw more power at lower levels than a Class AB, some of them. It depends on the design. They're all a little different. But you'll never get the signal-to-noise ratio that we're getting in our most advanced Class A/B designs out of a switching amplifier. Our A/B amplifiers may be 10 to 20 dB better. That's significantly better. Many Class D amplifiers, if they can push 100 dB for signal-to-noise, they're really doing good. Our Signature Series ATI amplifier is almost 130 dB.

Hipps: This may be the only amplifier in the world capable of 130 dB.

Kessler: But most Class AB amplifiers will be at least 10 dB quieter than a Class D, even the better ones. And noise is a distortion, by the way, pure and simple. **WSR**

To be continued in Issue 186, April/May 2014.