Subject: Re: Combining New With Old?
Posted by Wayne Parham on Fri, 01 Nov 2019 20:26:44 GMT
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To your point, many people are surprised to learn about the actual benefits of vacuum tubes. I was one of them.

When I was young, microprocessors were just on the horizon. In my teenage years, that was what was brand-new. Integrated circuits and computers on a chip were the latest technologies in the 1970s. Vacuum tubes were like horse and buggy stuff to me.

When I would hear guitar players talking about how much better they liked tubes, I just thought they were creating an artificial bias, sort of inventing an idea. Or that they were just full of shit. And to some degree, that was true.

Some of my musician buddies would talk about "tube watts" being more powerful than "solid state watts." I would explain to them that was really just because of "soft clipping." I knew at least that much about tubes, and I was right when I explained why their 30 watt tube amps seemed to be just as loud as 100 watt solid state amps.

But sometimes I would run into people that thought their tube amps were qualitatively better than solid state amps, and I dismissed their ideas as nostalgia or just nonsense. I assumed that bipolar transistors were more linear and distorted less.

The only advantage I could see that tubes might offer was better resistance to electrostatic discharge and EMF pulses. It stood to reason that after the discharge stopped - provided the metal hadn't pitted excessively from internal arcing - a vacuum tube would probably still work.

Other than that, I assumed that transistors were superior to tubes. It wasn't until the late 1990s that someone with technical background mentioned to me that the linearity of some tubes was better than the linearity of bipolar devices of similar power levels. The distortion-causing non-linearity is actually lower in many tubes than it is in solid state devices. That surprised me, and in fact, I doubted it.

So I looked it up for myself, and sure enough, I found that the actual active devices aren't what make modern solid state amplifiers have lower distortion than older tube amps. The reason modern amps have such low distortion is they employ a lot of gain stages and use more negative feedback. This reduces distortion by topology. A designer could do the same thing in a tube amplifier, but it would be huge because it would take so many tubes. If you build a minimal system with just a few gain stages and no negative feedback, the tube amp will probably outperform the transistor amp.

So this then brings into question whether or not a complicated design using negative feedback is better than a minimalist design without feedback, or with only local feedback like unbypassed cathode or emitter resistors.

Complex topologies that employ negative feedback can get distortion down to almost zero. They

do this by sacrificing gain, but make it up using more gain stages. But they also can potentially suffer from reduced stability, especially as they enter clipping in one or more gain stages. They can produce strange artifacts when pushed to their limits. At the very least, the distortion rises from almost zero to very high and with high-order harmonics that are most objectionable.

Minimalist designs tend to have higher low-order harmonics, mostly second and third. And they often have them in more pleasant ratios, with second being higher than third. So the harmonics tend to be inaudible, or possibly "warm" sounding. The "soft" clipping of tubes sort of adds to this characteristic, in that the tops of the waveforms are rounded rather than hard-edged, so harmonics stay in the low-orders. It just doesn't sound ragged. That's the old "tube watts" thing expressed a different way, but it does play hand-in-hand with the fact that the minimalist systems tend to have low-order harmonics to begin with.

All that to say there's more to it than just a pure tubes-versus-transistors discussion. There is also a topology discussion and those are separate things. If one were to compare a tube to a transistor and not consider anything else, they would find that the tube was often times a more linear device.

A Taste of Tubes