ISSUE
04
Volume 7

BRYSTON
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This Issue

About Digital (Class D) Amps

About once a week I get questions regarding Digital Amplifiers and where Bryston is going with this technology.

The following article was written recently by Bruno Putzeys - Chief Engineer at Phillips Class D Audio Systems Laboratory. It explains where digital technology is and what the future holds for this technology.

"Firstly I'd like to point out that 'digital amps' is a misnomer.

There are two categories:

1. ***Analog - controlled Class D.***

Switching amplifiers with an analog input signal and an analog control system. Normally some degree of feedback error correction is present.

2. Digitally controlled Class D.

Amplifiers with a digitally generated control that switches a power stage. No error control is present. Those that do have an error control can be shown to be topologically equivalent to an analog controlled class D with a DAC in front.

Both use switching power stages and have high power efficiency as their most eye-catching feature.

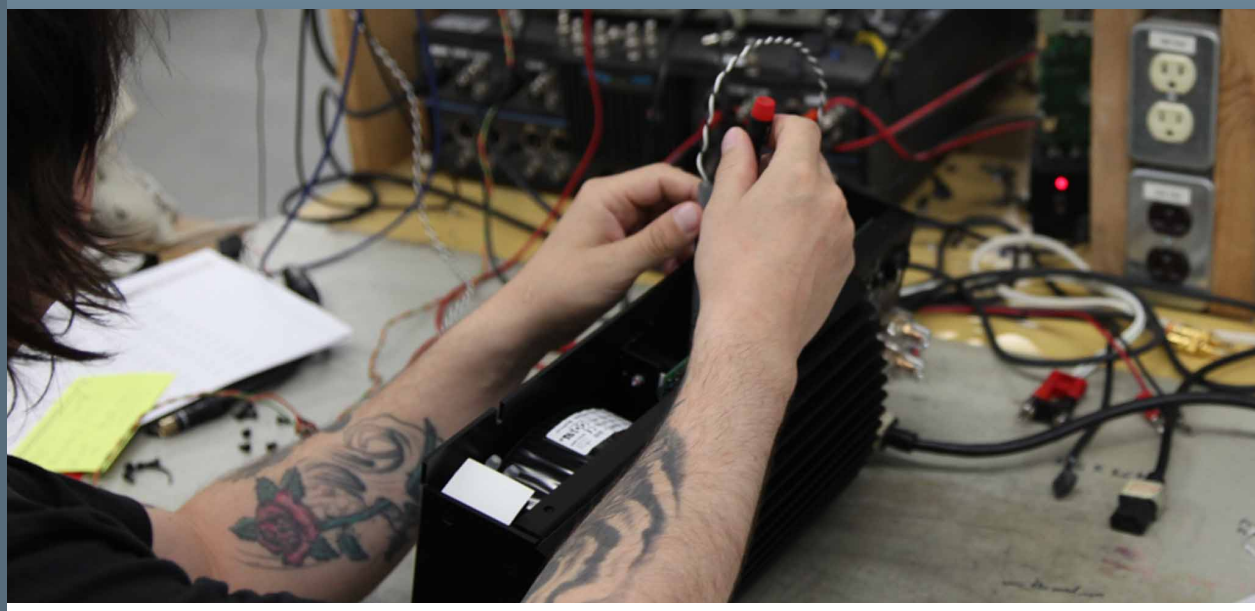
Why digital...

Digitally controlled class D initially delivered a success in the form of the Tact Millennium. However, by its mere existence this device (and another one of my own making, the "PPDSD" which performs marginally better) proves that obtaining good performance from such a contraption is largely an analog design exercise - a very complicated and expensive one at that. After all, the distortion phenomena that stand in the way between a perfectly formed digital control signal and a perfect analog replica are inherently analog. Similarly, cheaper digital class D's (such as SonyS-Master and TI's) go on to show that at practical price and complexity levels, performance is quite abysmal (better than 0.1% THD is unusual and be sure it isn't just third harmonic!)

One should ask the question: would any D/A converter designer in his right mind build a DAC using power components? Probably not. Then how about the old argument that digital-to-the-end is best? Well, I should think the D/A barrier is best put precisely where it allows the whole signal chain to perform at its best and why should we believe that this is necessarily right at the end? Quite obviously the concept of a digital class D amplifier was dreamt up by DSP folks who presumed that the signal should be kept out of the big bad analog world as long as possible, at the same time expecting the power stage, power supply and filter (all highly analog in nature) to perform flawlessly.

… or rather, why not?

Analog controlled class D is quite a different story. Although most commercially available implementations are well short of this ideal, proper error control can be used to make analog class D amplifiers with



performance figures giving the digital variety a run for their money, at a price well below that of even the cheapest digital class D's. They can have vanishingly low output impedance right across and beyond the audio range (which the digital ones can't!) while frequency-independent distortion (for that "zero-feedback sound") is actually easier to achieve than with digital ones.

So how about sound? The output filter's highish HF output impedance, when uncorrected (in amplifiers without post-filter-feedback, i.e. all digital ones and many analog ones too) is responsible for the oft-quoted tube-like warmth and air. At low frequencies the filter impedance is low, resulting in a commanding, dynamic bass. Because switching amplifiers previously had a reputation for sounding harsh (due to people who hadn't heard them but presumed that switching couldn't mean anything else), about every modern entry in the field was heralded as the "first audiophile class D". Read a review about the Bel Canto Evo or the Sharp 1-bit (which is analog, btw) to see what I mean. Keep in mind that if a device sounds radically different from what you've held in high esteem previously, there's usually something fishy going on.

Unfortunately, while warm and airy is nice, it isn't all you need for real audiophile sound. I like to think audio components should sound neutral and transparent too. A frequency response that wanders 10dB off the line at 20 kHz isn't conducive to neutrality. High THD isn't good for transparency, especially when it goes up with frequency. Ergo the Tact Millennium (which has flat and low THD but a non flat frequency response) sounds transparent but not neutral, and your average transistor amp (which has low output impedance but sharply increasing THD) sounds neutral but not transparent.

Now, the technology (if you can call a circuit with 16 transistors that) to deliver low output impedance with frequency-independent low distortion in class D exists. Built with audiophile-grade parts it'll scare the pants off any high-end amp (while I'm the designer of that circuit and thus some care reading this statement is warranted, I do have a lot of serious folk to back up my claims). Of course, having these characteristics it sounds more like other high-end amps than that it sounds different, in the same vein as that the best tube gear and the best solid state gear don't differ by miles in sound.

The upshot...

Digitally controlled class D: dead end street. Analog controlled class D: definitely the future, although you shouldn't expect it to flatten competition from traditional solid-state and tube amps by a tremendous margin.

In the very high-end segment the three are bound to coexist for a very long time. In mainstream gear, class D is certain to take over the scene completely, although one serious problem remains: building a good class D amp is an order of magnitude tougher than a linear amp, and the knowledge required is much more diverse. It may take long before each large company has at least one knowledgeable designer. It won't stop them from putting class D based products on the market, but until then and unless they buy completed amplifier modules from specialist vendors (which eastern

companies rarely do, they'd rather commit harakiri than having to swallow their pride), they will be putting out seriously substandard products for years to come.

Bruno Putzeys.

Chief Engineer, Phillips Laboratories."

So you can see that the so called superiority of Class D amplifier technology has been greatly exaggerated. Good old well designed 'linear' analogue amplifiers (of which Bryston represents the best available) are here to stay. Class D amplifiers with their open loop digital pulse width generator exhibit all the attendant disadvantages of Class D designs namely, poor frequency response linearity, high noise and sensitivity to power supply ripple.

Class D designs certainly have a place in sound reinforcement, 70 volt applications, mass produced mid-fi products like receivers and subwoofers where low cost, low weight and high efficiency is required but if State of The Art sound is what you're after - not so fast! At Bryston we are constantly looking and searching for better ways to build audio amplifiers and we have and will continue to evaluate and test these Class D designs (or any other technology that comes along for that matter).

Distinctive from Class D amplifiers, all Bryston SST Series amplifiers have low noise, low output impedance and vanishingly low THD that is constant with frequency. Bryston will continue to research in the direction that gives our customers the most accurate audio amplifier performance available.

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