Is Class-D Amplification Digital Amplification?

By Dan Fraser

The signal has at some stage to be in the form of digits to be called digital. And the analog PWM that ICE Power, Tripath and many others use never represents digits in the path. On the other hand, some Class-D amplifiers made by Texas Instruments and all the amplifiers by D2Audio that include digital processing are true digital because the analog audio signal is converted into a stream of binary digits for processing before being converted back into analog audio at a later stage.

Class D amplifiers, which use PWM alone, are NOT digital. The people at ICE Power where I get my Class-D modules get quite offended when you call their amplifier modules “digital”.

Class D works by varying the pulse width of a switching waveform in a number of steps, in step with the amplitude of an audio signal. That is, the width of the pulse at any instance is an "analog" of the amplitude of the audio signal. The audio signal is recovered from the switching waveform with a simple passive low pass filter.

Many Class-D amplifiers are really analog because the input to the power amplifier is an analog signal and is directly converted to a Class-D output signal, generally through some sort of modulator. There are an infinite number of possible pulse widths, meaning the pulse width is an “analog” of the signal, hence the amplifier is analog and NOT digital. People confuse these with digital because the output stage switches between two distinct states and sort of mimics a digital signal. Still, the PWM signal is an analog (albeit a distorted analog) of the input signal; it is not a representation of measurements of the signal.

A true digital Class-D amplifier is one where the audio signal is converted, by an A/D converter to a digital signal, one that cannot be converted back to audio except with special active hardware, a digital to analog converter. In this case, the signal is converted to a series of digital words and is digital in every sense of what digital means. This signal generally leaves the A/D converter in a serial formal called I2S. This signal may then be manipulated in a digital signal processor or even saved on a hard drive. The signal is then applied, still in a digital format like I2S to an I2S to PWM

converter like the Texas Instruments TAS5012. This IC then converts the true digital input into a pulse-width-modulated (PWM) output. While this signal is an "analog" of the original music, it is considered to be digital because there are not an infinite number of steps like analog class D has. The output signal can only step in fixed amounts depending on how many bits are used in each digital sample of the audio signal. Generally between 16 and 24 bits.

The true digital amplifiers can be identified because their THD+N generally rises as the signal amplitude goes down, because the signal is using fewer and fewer of the available bits as the level drops. Analog Class-D amps are a lot like linear amplifiers where the best THD+N is at some lower level. Generally, the analog Class-D amplifiers sound better.

The whole BS came around where people started to use "digital" as a buzzword. Many years ago, when I started to see speaker cables that were sold as "Digital Compatible," I knew we'd be in for this sort of misunderstanding.

I have intimate knowledge of some of Tripath chips (not all, though) and as far as I can tell, they do analog PWM modulation. I could find no evidence in their literature that they convert the audio into a form of PCM (pulse code modulation) which is a TLA (three letter acronym) for true digital encoding. The signal is never converted back to analog audio through a converter that does pulse width modulation with a given number of steps corresponding to 2^ (number of bits encoded).

If they wish to call what is an analog process "digital," that's their business; but, to me, they have not proved their case. All I can find in their spec sheets is a reference to processing and modulation.

There is no reference at all about converting the signal to true digital format and they do not appear to be much different to what I can see than the ICE Power modules, modules that claim to be completely analog.

The Tripath modulation is buried in a chip so we cannot tell for sure what is in there but, if it were really digital in there, I would think they would brag about it.

I get the feeling that they threw in the term "digital" as a buzzword to help them raise money, and now they're stuck with it. That is possibly a reason why the spec sheet for a device like the TA0105A refers to "digital" very little after the first page.

I could be wrong about Tripath, and I have respect for their being able to sell what is otherwise a fine product. After testing the TA2022, I chose to not use their product, but it was for other reasons.

All I can say is they have not proven their case to having a really digital product. Basically, this is a semantics battle and—without knowing what goes on in their chips—they can say whatever they want and, in the long run, it matters not. Their products do work as advertised, even if the label is a little iffy, and, from a technical standpoint, there is no reason not to use their products.