Audio Myth - "Switching Power Supplies are Noisy"

This M Goes Something Like This:

"Switching supplies are noisy."

"Linear power supplies are best for audio."

We disagree!

About 5 years ago, Benchmark stopped putting linear power supplies into our new products, and we replaced them with switching power supplies. We did this because linear supplies are too noisy. Yes, you read that correctly, linear supplies are noisy! **A well-designed switching power supply can be much quieter than a linear supply.**

Linear Power Supplies Cause Hum

The noise problem is due to the fact that linear power supplies have large transformers and other magnetic components that operate at the AC line frequency (50 Hz to 60 Hz). These line frequencies are audible, and we are all too familiar with the hum and buzz that audio products can produce. It is no secret that this noise is caused by the power supply, but few people understand why it can be so hard to eliminate. Most people think that hum is caused by conducted interference (AC ripple on the power supply rails), but this is rarely the case. Most AC hum is caused by magnetic interference, and this can be very hard to eliminate.

Hum is Usually Caused by Magnetic Interference

Transformers are magnetic devices. Power is magnetically transmitted between a transformer's input and output windings. In a linear supply, power is transmitted from the AC line side of a transformer to the low-voltage secondary side using an AC line-

frequency magnetic field. Unfortunately, transformers are never perfect, and some energy always escapes through stray magnetic fields. These stray fields can interfere with virtually every electrical conductor in an audio product. Magnetic shielding is expensive and it has limited effectiveness when sensitive circuits are located in close proximity to a strong field.

Power Amplifiers are the Worst Offenders

The power supplies in high power devices, such as audio power amplifiers, can emit very strong magnetic fields. These strong fields tend to limit the noise performance (SNR) of power amplifiers. These magnetic fields can also cause interference with audio products that happen to be too near the amplifier. Audio cables that enter, exit, or pass near the amplifier may also pick up unwanted hum and buzz. For this reason, it is usually very important to keep the power amplifier well separated from cables and other components in the audio system.

Breaking All the Rules!

Benchmark's new AHB2[1] power amplifier breaks the rules. It can even be located adjacent to sensitive audio components without causing interference! The AHB2 is a high-power device, but it emits almost no magnetic interference. What makes it different?

The secret inside the AHB2 is the switching power supply. This power supply has several high-power transformers, but they are very small, and their stray magnetic fields are correspondingly small. The reason for this is that the magnetics operate at 200 kHz to 500 kHz. For a given power rating, transformer size decreases as the operating frequency increases. High-frequency transformers have smaller cores and fewer turns of wire. As the physical size decreases, there is a corresponding reduction in stray magnetic field strength.

Size Matters

When transformers are physically small, there are more options for magnetic shielding. For example, the small transformers used in the AHB2[2] are completely encased in a ferrite material which helps to contain stray magnetics. These techniques are so effective that the AHB2 achieves a SNR of 130 to 135 dB. No power amplifier is quieter than the AHB2. Even more amazing is the fact that the switching power supply

board is less than an inch above the amplifier board. This product proves that switching power supplies can be very quiet! The AHB2 could not achieve this level of performance with a linear supply unless the supply were housed in a completely separate box a couple of feet away.

Out-Of-Band Noise

One major advantage of switching supplies is that the operating frequency is above the range of human hearing. If interference occurs, it will not cause audible interference. This interference can even be removed with a filter without infringing on the audio band. But, the power supply in the AHB2[3] is so quiet that we do not need to filter the audio output. The AHB2 delivers a 200 kHz bandwidth without evidence of any significant switching noise, to a measurement limit of 500 kHz.

Linear Amplification with Switching Supplies

Please note that the AHB2[4] is **not** a class-D switching amplifier. The AHB2[5] is a linear class-AB amplifier. It is only the power supplies that operate in a switched mode. The power supplies simply provide steady and constant regulated DC voltages for the linear audio amplifier.

Efficiency

Another major advantage to switching power supplies is that they can be very efficient. The power supply in the AHB2 achieves an efficiency of over 90%. This means that very little power is lost to heat.

In linear power supplies, massive amounts of power can be lost in voltage regulator circuits. In contrast, switching supplies can produce steady, regulated, DC outputs without consuming extra power.

The Advantages of Regulation

Most traditional power amplifiers have unregulated linear power supplies. Regulation is omitted in order to save power and reduce heat. The negative consequence of this is that the power rails sag with every musical peak. In traditional designs, large banks of capacitors are connected to the voltage rails in order to reduce this voltage sag to manageable levels. Nevertheless it is common to see a significant increase in

distortion (THD) when these traditional amplifiers are heavily loaded.

In contrast, the AHB2[6] has a tightly regulated power supply. This means that the amplifier board in the AHB2[7] sees constant DC voltages that do not sag when the amplifier is cranking out the watts. The AHB2[8] does not need, or have, massive banks of capacitors because the power supply responds to the dynamic requirements of the music. This helps prevent any rise in distortion when driving heavy loads, which is one of the reasons why the 8 Ohm, 4 Ohm and 2 Ohm THD numbers for the AHB2[9] are nearly identical.

[10]

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Switching Supplies Must Be Optimized for Audio Applications

This discussion would not be complete without pointing out that many switching supplies are noisy. Older designs and low-cost designs tend to use lower switching frequencies that fall within audible frequencies. Many small cellphone and computer chargers fall into this category. These devices can cause interference when placed in close proximity to an audio component or cable.

The switching supplies used in Benchmark products are specifically optimized for audio applications. These switching supplies are much quieter than traditional linear supplies of similar size.

Video Demonstration - Seeing is Believing!