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Subject: Re: Awesome discussion!

Posted by [Wayne Parham](#) on Sat, 22 May 2004 09:55:16 GMT

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That's a good link, thanks. Right on target. You might make a note that half-wave rectifiers provides a line frequency (50Hz or 60Hz) pulse train before filtering but the full-wave rectifier "fills in the holes" and makes a 2X-line-frequency (100Hz or 120Hz) pulse train. The circuit flips conduction every half cycle to use both sides of the waveform. Bridge rectifiers are commonplace in solid state devices because four diodes don't cost that much. I'm not an expert on historical tube circuits by any means, but I don't think that bridge rectifiers were as common in tube systems, and I think single diode rectifiers and dual-diodes were most often used instead. As for power supply filters, it's very much like the situation found with loudspeaker crossovers. Higher-order filters suppress more in the stop band. Also, whatever slope is used (first-order, second-order, etc.), frequencies further into the stop band receive more attenuation. So the idea is to make a filter that's low-pass, since all we want is DC, or 0Hz. Pretty much the larger the values, the better. A full-wave bridge presents a 2X (100Hz or 120Hz) pulse train instead of 50Hz or 60Hz, so the doubled frequency is further into the stop band, so more attenuation. And by using larger values and more filter poles, you increase attenuation of the primary ripple frequency as well. This is all pretty much just basic filter stuff. You make a basic low-pass filter for power supply, and possibly a series choke or resonator between the supply and load to reduce ripple further. You can visualize the circuit having perfect inductors and capacitors for this part. But one thing to consider is that the inductors have a series resistive component, and capacitors act like they have a resistance in series and in shunt. Large electrolytic capacitors, in particular, lose their effectiveness at high frequencies, so it sometimes makes sense to use a small value capacitor directly across large ones, or in strategic places in the circuit to counteract for some of the effects of real-world imperfections in parts. That's why I mentioned having some small capacitors across diodes. They'll shunt the switching spike. And small capacitors might also be employed across large electrolytics, to reduce the relatively high frequency components that pass through the power supply. Most of the noise coming out of a rectifier circuit is low frequency stuff. But there is some high frequency energy there too. It's attenuated, but if the filter components are ineffective at midrange frequencies, some noise might get through. Using smaller value bypass caps helps to reduce this. There are two things at issue here, one that is probably more important in small and medium power supply circuits like are used in home hi-fi systems. There is a time when a rectifier goes open, which introduces a small switching spike. This can be pretty significant on high-voltage, high-power systems and you'll see small caps across solid-state switching components in circuits like those. The spike from going open in a high-current circuit can be pretty large under certain load conditions. Even though the crossover voltage is low, at very high currents, the switching spike can be alarmingly large. All line-cycle rectifiers generate a series of pulses having sine curve half-cycles broken by sharp edges where rectification switching has occurred. These transitions correspond to high frequency artifacts. So while the power supply filter is generally thought of as a very low-pass circuit, maybe with line-frequency or 2X notch filters, it still should have some ability to attenuate frequencies several times the line frequency. If the power supply filter becomes ineffective at high frequencies, there will be some noise at high frequency multiples of the line frequency. So that's why quality power supply capacitors are important, and if large electrolytics are used, smaller value bypass caps might be used as well.

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