The HiFi Mantra – Source First

"The mains power supply?" I hear you ask. How on earth is this relevant to hifi? It simply provides the power. It is a little known fact that your 240V mains is one of the most important factors in getting the best out of your hifi system. You may have heard it said that the most important component of the hifi chain is the source component. After all, garbage in, garbage out! But have you considered that the 'source' of power (or everything for that matter) for your entire system is the mains?

Nobody thinks much about the 240V mains power that comes into your home. You flick a switch and the light comes on. You press a button and your kettle boils. It's just there. It powers everything in your home and nobody gives it much thought.

However to those in the know, your mains supply is a double edge sword. It provides the power for your entire hifi system, but it also poses a deadly threat to musical nirvana. Have you ever noticed how involving your hifi system sounds at the end of a late night music session? The reason your system doesn't normally sound as musically involving and dynamic as it does late at night is because of mains voltage problems.
To understand why, we need to explain a little of how the electricity supply works and how it impacts your hifi system.

The power supply section of your amplifier (for example) takes this oscillating voltage and creates a stable constant voltage level called the supply rail voltage that powers the sensitive circuitry. The power amplifier uses this stable supply voltage to create the output voltage used to drive the loudspeakers. It uses the delicate low level input supplied from the preamplifier or source component and boosts the level with power from the supply rail.

Here is the important part. Any variation in the supply rail voltage finds its way into the final output signal corrupting the musical signal. That is why the power supply section is often the first part of an amplifier that hifi tweakers modify and improve. In all but a select few of the finest components available, the power supply is compromised by design, typically because a product is designed to a price point.

So how does the mains supply affect the supply voltage (and hence the music) and why are we so concerned about mains anyway?

Irregularities in the mains supply from your power company are a part of life. The voltage can be higher than 240V, lower than 240V, there can be irregular sags and dips in the voltage, there can be voltage spikes, fluctuations in frequency, and the list goes on. In fact, all the electricity supply company is obliged to do is provide 'roughly 240V'. They generally have a tolerance of 10% which means it can vary from below 220V right up to 265V and still be OK from their point of view.

All of these types of irregularities find their way through the power supply section and cause variations in the supply rail voltage. This then affects the delicate audio signal leading to a degradation of musicality. More on that later…

Now, let's take a look at the different types of mains problems in a little more detail and how to overcome them.

High or Low Voltage

The Mains voltage at your wall socket should ideally be 240V rms. I won't go into the details of what "rms" means, other than to say it is a complicated measure of the average AC voltage. The actual voltage delivered can be very different. As previously stated, it can be anywhere from about 220V to 265V and still be considered correct. Moreover it can vary considerably over short periods of time.

To understand why you must consider how electrical power gets to your home. The power station generates very high voltage in the order of hundreds of thousands of volts which is most efficient for transmitting over long distances. High tension power lines – the very high towers running from the power station to the city as shown below carry this voltage. A local substation takes this high tension voltage and drops it down to around 11,000 volts for transmission along city streets. The last stage of the power chain comes with a Stobie/telegraph pole mounted transformer which takes the 11,000 volts and drops it to the 240V that you use in your home. It is a very long chain with many steps down in voltage. This is part of the reason that it is difficult to maintain an exact 240V level at every house.

The actual voltage delivered to your house has a huge impact on audio components. Consider for a moment how a turntable or CD player works. The motor speed of DC servo units is voltage controlled. A voltage regulated power supply is always employed, but changes in the mains voltage will have a small but perceptible effect on the actual voltage driving the motor. Changes in the speed of playback affects the pitch and rhythm of music and this is quite noticeable. On this basis you would think that a synchronous turntable motor would be better, but there are other more degrading mains related effects that come into play. These will be discussed later. Suffice to say a properly designed DC motor turntable will be better than a synchronous one, all other things being equal.

Variations in Voltage

To complicate matters, the amount of power used affects the voltage. Have you ever noticed how the lights sometimes dim slightly when your fridge turns on? When the compressor in your fridge turns on, it requires a huge amount of current to get started. It can draw tens of amps for a fraction of a second. This causes the mains voltage to drop temporarily resulting is the noticeable dimming of the lights. There are smaller but noticeable changes in the mains voltage every time any equipment in your house (and to a lesser extent in your neighborhood) turns on and off.

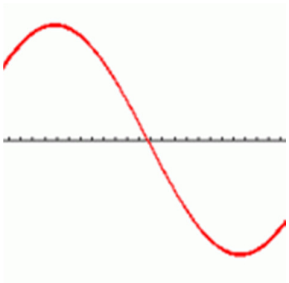
So the bottom line is that mains voltage isn't ever really 240V and it is varying all the time with changes in what is actually being generated by the power station and varying loads in your house and nearby houses.

Variations in Frequency

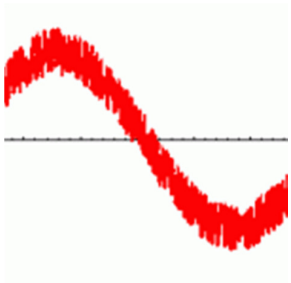
Variations in mains frequency occur all the time. The Australian power supply is only required to be 50Hz averaged over a day. At times of peak demand, both the voltage and frequency drop. Often, the mains frequency is increased at night in order to ensure that the average daily frequency is the required 50Hz.
Turntables are generally the only audio component generally affected by changes in the mains frequency. This only relates to turntables with synchronous motors. The rotation of synchronous motor is directly locked to the mains frequency. It is synchronous with mains frequency. Therefore if the mains frequency is higher than nominal, the motor runs faster and everything increases in pitch and tends to sound exciting and bright. On the other hand if the frequency is low, the music can sound slow and dull. Worse still is when the mains frequency changes rapidly. In this case, the platter subtly changes speed all the time, possibly introducing audible sonic degradation. DC motor turntables are immune to mains frequency variations and all things being equal, I'd rather have a properly designed DC motor turntable than synchronous motor turntable.

"Noise" on the Mains

Just as devastating to audio performance is mains "noise". Any variation in the mains voltage other than a pure sine wave is considered noise. Perfectly clean AC mains power is a sine wave voltage as shown below left. A real world AC Mains signal looks more like the figure below right (exaggerated noise level for illustrative purposes). The 240V signal is still there, but there are short term (and sometimes not so short term) transient variations



Clean Mains (Perfect Sine Wave



Noisy Mains (Sine wave with noise)

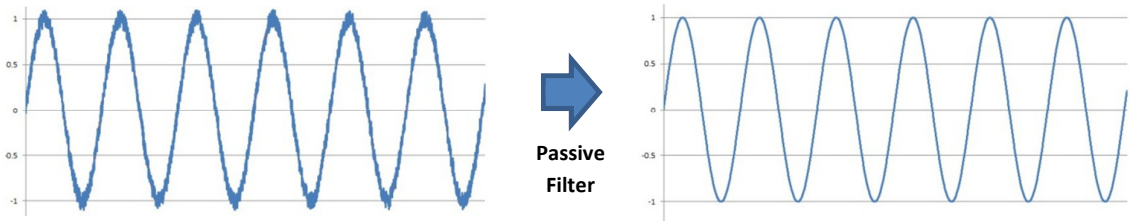
Power Conditioners versus Mains Regeneration

A mains power conditioner can make a significant improvement in the quality of your mains supply and hence the audio reproduction, but it is only a band-aid solution. A power conditioner is quite simply a filter. It can never fix all of the problems on your mains and will also introduce some additions limitations.

Let's consider the analogy of dirty water. A household water filter can clean it up to some extent, removing all of the visible impurities but it can't produce pure water. The only way to purify it is to boil the water, collect the steam and condense it into a clean cup. You have in essence regenerated water from steam - pure water. It is the same with dirty, distorted mains. Filtering can only do so much. To purify it, you need to completely regenerate it from scratch. Complete reconstruction of a mains voltage in your own house is undoubtedly the best solution.

What are the limitations with a passive power conditioner? First let's consider how a mains filter works. It is essentially a low-pass filter that lets through low frequency signals and only attenuates the highest frequency components of the mains signal. This works very well at removing the "noise" component from mains. It does this by restricting or impeding the flow of electricity for the highest frequencies – it restricts the ability of electricity to flow through it. While this effect is greatest at high frequencies, there is nevertheless an impediment to the overall flow of electricity. This has quite a significant detrimental effect. Any added impediment to the flow of electricity will degrade your audio performance. Consider what happens during musical transients. Reserves of power are drawn from the power supply of your power amp and the internal voltage droops slightly. The sooner this can be recharged from the mains supply, the better the reproduction. This is why you want the fastest possible recharging of the power supply, the mains supply with the lowest possible impedance.

The diagrams below demonstrate how a noisy mains signal is cleaned by a passive mains filter.

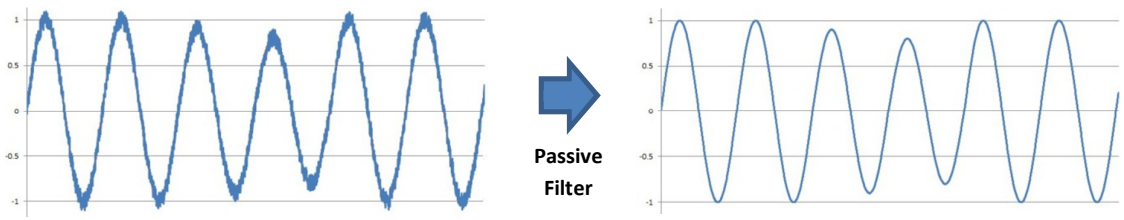


Mains regenerators on the other hand take the poor quality mains, convert it to DC and store that energy before generating a completely new, clean, perfect sine wave mains voltage. They completely remove mains noise but they also fix many other unseen problems. The most significant point is that because of the huge reserve of stored power, a regenerator can actually deliver electrical power 'faster' than from the wall socket for transients. This allows your components to respond to musical transients much more accurately.

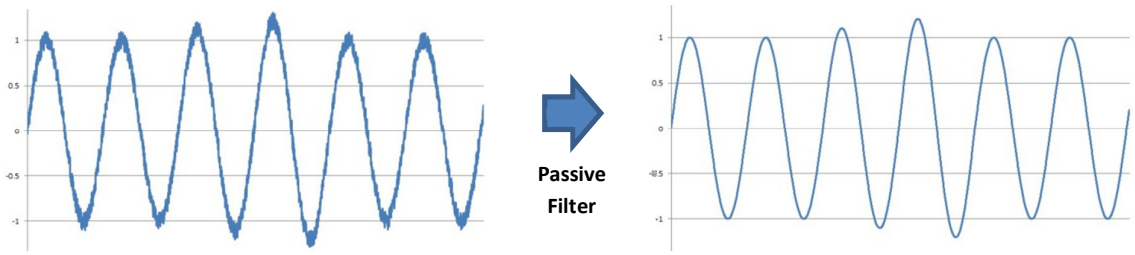
A power conditioner increases the impedance to electricity flow while a regenerator *reduces* the impedance, allowing the big power amplifier to replenish its internal supplies much faster during musical transients. The PS Audio P10 can deliver up to 70 amps of transient current, while your wall socket is rated at a 10 amp circuit. The result is a much more cohesive and musical presentation. The music comes alive!

Let's look at voltage dips and overvoltage bursts. Consider a noisy mains supply that "sags" over a couple of cycles. This is what happens in a "brown-out". Have you noticed that when you turn on the air conditioner, the lights dim? This is an extreme case of the brown out. Brown outs happen all the time. You don't always notice the lights dimming, but the supply is dipping and fluctuating all the time. Every time your neighbor turns on the air conditioner, the over, the kettle. Anything that draws a large current will cause a noticeable temporary droop in the mains voltage. This is happening in every house, every business, every minute of the day. The mains is a mess.

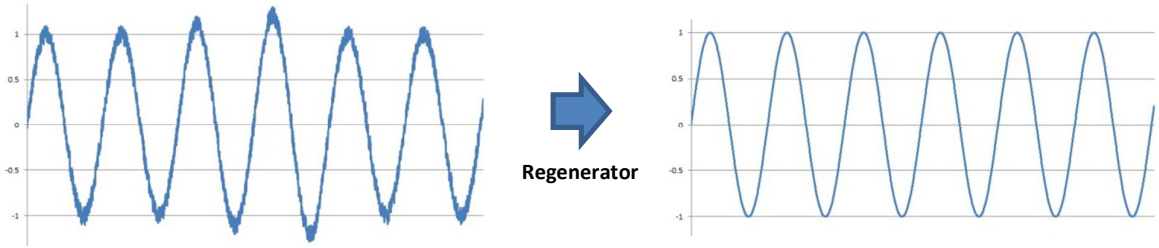
A brown out is demonstrated in the graphs below. The power conditioner remove the high frequency "noise" component – the fuzz on the mains – but the voltage instabilities remain. Passive filters can't do anything about the constant brownouts that wreak havoc with the musicality of your system.



A similar situation occurs with the other end of the spectrum, overvoltage. This is a common occurrence in Australia. The voltage is officially 230V +/- 10% to be in line with other countries but in reality the power generation equipment has not changed from when we were officially a 240V country. In practise, voltages of 265V are commonly seen at the power point. Again, a passive filter can do nothing to fix this problem.



A regenerator fixes all of that. The incoming mains is converted to DC and stored on board before being converted into a new, ultra-low distortion, sine wave perfect, ultra high current new AC. While it's far more complex than this, think of having a sine wave generator feeding perfect new sine waves into a high current Class A/B power amplifier that drives the new sine waves into new, phenomenally pure AC. The difference this makes to your existing hifi system performance is staggeringly obvious. Every one of your components is instantly able to operate at their full potential. Mains regeneration gives you an upgrade of each and every component in your hifi chain – all at once. Active, high current, sine wave perfect AC. It doesn't get better than this.



What does it mean for the music?

A mains regenerator will completely transform your entire system. It quite simply upgrades each piece of equipment you currently own. It allows them to perform at their true potential. When people live with a mains regenerator for a few weeks they are unable to return it. It is one of those "ah-ha" moments.

The changes aren't subtle either. Not louder, not blaring. Just cohesive, goosebump producing, three dimensional ***music***. The music just embraces you.

PS Audio introduced the first power conditioner for home audio, using isolation transformer based technology, the same technology most companies still employ today, over 33 years later. In 1987 PS Audio, recognizing the inherent limitations in transformer based isolation filtration, went to the core of the issue and introduced patented technology that regenerates Sine Wave Perfect, Ultra Low Distortion, High Current AC. The world's first AC Regenerator was born and awarded Product of the Year acclaim by the industry at large.

PS Audio's true Active Regeneration provides a whole different level of high performance.

1. Perfect Sine Wave reproduction that is maintained at all power levels.
2. Ultra low distortion output that typically is .1% to .2%, superior to any device known.
3. Voltage regulation that allows you to choose the voltage of the new AC being regenerated and that is what is constantly delivered to your devices.
4. No more brown-outs or over-voltage.
5. Mains noise is eliminated.
6. Massive reserve current of 50 amps to 70 amps is maintained and available for output to ensure dynamics, headroom, and consistent performance is always delivered.
7. Ultralow output impedance which is critical to the transfer of power to your hifi gear

PS Audio AC Regenerators deliver the cleanest, most powerful AC current available today, period.