

MAINS POWER AND HOME AUDIO

part 1: mains supply & cables

Introduction

Does your Hi-Fi system sometimes sound great and sometimes dull and undynamic? Do you hear clicks and pops through your speakers or a low level hum due to buzzing transformers in your audio kit?

These issues can all be due to the state of your power supply. Improving your mains supply cabling can improve the performance of your audio system, including some of the above problems. The question is, how can power cables influence your audio - what might they improve and how much might it cost?

UK mains supply

In the UK we have a particular mains power problem - there are a lot of us on this small island, and mains power usage varies throughout the day. Power station control systems need to predict when we all need our power and provide it to suit. The voltage ought to be within 220-240 volts, and generally, but occasionally it can fall outside these limits. UK mains power is alternating at 50 Hz, and this is always very stable and rarely drifts - mains powered electric clocks keep excellent time based on the stability of this frequency for instance, and every power station on the grid has to keep in perfect unison, or the grid would not work.

There are a lot of claims made that the UK 240VAC mains supply is often 'dirty', and contaminated with DC (non-alternating) current and voltage 'spikes', plus very high frequency waves from both radio and mobile phone transmitters - in urban and industrial areas particularly, and that this can be a real problem for audio. Is it? It's easy to misunderstand the fundamentals and get seduced by the claims made by audio cable manufacturers and possibly spend money on poor or overpriced mains power products for audio.

Most of the many thousands of people who now use upgraded mains power products in their audio systems started out as sceptics - as we did. But we have found that power cables and conditioners can have a positive impact on performance - take a good Hi-Fi system and make it sound great or at least a whole lot better. But there are some products that seem to help in one area and fall down in another, actually making the sound worse overall. Cables cannot sort out every problem on the mains supply...

Here is our background information and guide to help you.

UK mains supply - getting power to your audio equipment

There are a number of issues which can affect the sound of your audio system that are caused by the power supply into your audio equipment. Ideally, your audio equipment works best with a constant supply of perfectly alternating (AC) voltage around 230 volts and with limitless current potential offering instant power (low impedance), so that when your amplifier calls for instant power, it is indeed

supplied instantly and cleanly. A perfectly clean and infinitely low impedance connection to earth is also required.

Commonly though there is a higher than perfect low impedance (think low resistance) on both the power line and earth lines. The 'instant' clean power and perfect earthing is limited to some extent. Anything we can do to improve this situation is a good thing for audio quality. There will be some very high frequency 'noise', maybe some clicks and pops from spikes of high voltage, a DC voltage running in the power line, causing transformers to buzz and finding its way through to the speakers in the form of a hum. The cables from your equipment to the wall socket or distribution block can resolve some of these problems, but not all of them.

UK mains supply - how it works, why it's not perfect and how to improve it for audio equipment

There's an awful lot of power cable between your audio equipment and the power station, so how can a few meters of cable to the wall socket from the Hi-Fi make any difference at all?

There is good scientific reasoning to demonstrate that low impedance cabling, high frequency filtering and DC voltage blocking can improve the quality of your audio equipment operation (and the sound) if done correctly. You can experience a lower noise floor, so the silences are silky black; lower levels of distortion, hear greater definition between instruments, less constrained dynamics and better stereo presentation so the music sounds more real and involving, even in quite modest audio set ups.

There's a lot of misunderstanding about this issue. Do 'audio quality' power cables have any effect on your audio system? To understand what cables can do, first you need to understand the fundamentals of alternating mains electricity.

Popular misconception No. 1

AC Power is like water coming from a large water tank (power station), flowing through a hose into the home and onto the Hi-Fi.

NOT TRUE.



In-fact, your Hi-Fi components sit between two power wires, the live and the neutral conductors and the mains AC power alternates back and forth at a 50 Hz between these two conductors. So power does not 'pour' into your audio components along a cable from the power station at all - they are sited within a network of both live and neutral wires, the power (current) alternating between them.

Popular misconception No. 2

AC power can be contaminated just like water in a hose. That once the water is contaminated at some point up stream, it must be cleansed before it arrives at the audio component.

NO.

The component is not at the end of the power hose. It is between two 'power hoses' and the current (water) is oscillating back and forth to produce the electrical energy – this energy is not really like water at all. Electrons cannot be 'contaminated' but the perfectly smooth alternating wave between the two cables, as sent out by the power station can and is subtly altered because everything connected to those cables impact on the 'purity' of the alternating wave and in some cases, switches and other electrical devices produce high voltage 'spikes' on the alternating supply – and worse – some equipment injects small amounts of Direct Current (DC) onto the cables.

Popular misconception No. 3

There are hundreds of feet of wire in the walls, miles of cable from the power station, so the last 6 feet of power cord can't possibly make any difference.

The point is, the mains power cord is the FIRST 6 feet attached to your equipment and this is the most important part of the audio power circuit your equipment is 'seeing'. All audio equipment, particularly amplifiers need a low impedance power source, so they can call on lots of current instantly, to offer realistic musical dynamics. The cable attached to the back of your amplifier or CD player or streamer is intimately part of the power circuit in that equipment, not the end of one long cable from the power station. What about the electrical interference on the mains coming into our homes?

Popular misconception No. 4

There is a tremendous amount of electrical interference and very high frequency interference coming from outside the home that we need to protect our equipment from.

Do we need some sort of power conditioner or filter to protect the equipment and remove interference from the incoming mains?

Because the designers of our power supply system do not want troublesome 'noise' on the mains supply – they are power suppliers after all – the cabling outside your house is designed to reject high frequency signals (RF) – and they do this pretty well – but not perfectly. Most of the 'noise' that affects the audio quality of your Hi-Fi system is actually generated by the audio components themselves. The popular belief that radio waves are a big problem because power lines are big aerials is quite untrue. Very high frequencies that do get into the power lines do not survive for long, mains power cables present a high impedance to very high frequency (MHz and GHz) RF signals due to the relatively high inductance of the power lines, so radio frequency and high frequency signals do not travel along mains cables for long distances – if they did, we would all be using the mains to pick up our radio, telephone and TV signals! These high frequency signals do however enter cables and present a problem locally, close to your audio equipment.

The main source of audible sonic degradation is caused by the power supplies in our own audio/video components themselves. Virtually all power supplies in audio equipment use switches (called full wave bridge rectifiers), and these generate an incredible amount of switching 'noise' when the rectifiers switch on and off at 50Hz, because the alternating current from the mains needs to be

converted to smooth and constant direct current (DC) for the audio electronics to work. These switches in your audio equipment react with the incoming alternating mains current and alter the waveform slightly (mains noise). It's the reduction of this noise that an audio mains cable can have most effect on.

The design of a power cable can significantly affect the impact of the switching noise in both directions, to and from your audio equipment. The power cables you attach to your equipment are really part of the audio power system. The transition between the various metals used in a power cable and its connectors can cause electromagnetic reflections and diode-like rectification of the noise impulses as they propagate away from the switching power supply (apologies if this is getting too technical). The insulation used around the wires in a cable has dielectric properties - different insulating materials act like filters or reflectors and have a big impact on the alternating signal and its noise component. If power cable is designed to reduce some of the mains 'noise' they can and do improve the sound quality you hear.

Conclusions:

As long as audio power supplies use switches to rectify the incoming AC power into DC current to use in your audio equipment, power cords will always have a significant effect on sound quality. If designed properly, the mains cable you fit to your audio equipment can reduce some mains noise, both incoming and outgoing, at some frequencies.

The power cable attached to your audio equipment is conducting AC power and its sonic impact quality will primarily be determined by its ability to deliver clean alternating current, both steady-state and instantaneous to your audio equipment. Its ability to deal with the 'noise' effects of the audio components to which it is attached and generally reduce the noise your equipment is making, getting back into the cables and into your other audio equipment. This is important.

A power cable is composed of live and neutral wires that the audio equipment sits between plus an earth wire. An increase in the length of the audio power cable can increase the connected power supply "buffer" between each audio component. There is no real reason (except cost) to ensure your mains audio cables are as short as possible - unlike audio signal cables, where there is very good reason to keep them short (see our information sheet on signal cables).

Mains cables can increase the quality of the sound you hear – but will not get rid of mains voltage 'spikes' or DC on the mains cabling. They can help isolate each part of your audio system from the influence of the other equipment to some degree, and certainly can ensure the equipment they are attached to can work better if not optimally.

Our findings

Every power cable design has its own 'sound' or effect on the audio equipment it is attached to. There are very expensive power cables available along with some more cost effective alternatives.

How to choose?

1. Impedance. This means, ability to offer high current when required. The cable diameter, the cable design, insulation around the conductors, the terminations - will all impact on this. It is not the case that larger conductors are necessarily better. Some insulating materials are better than others. PVC coated cables do seem to be the worst sounding (and all cheap cables are made of PVC or something similar). Silicon rubber, PTFE and exotics like silk and cotton are good insulators that do not reflect noise back into the cable, but seem to reduce it and possibly dampen some of the HF and UHF frequencies picked up locally. There is scientific evidence for this.

Low impedance cables are made from low resistance materials. Copper and brass are very good electrical conductors, as is silver. High purity materials are better conductors generally. Low impedance connectors (the plugs at both ends of the cable) need to offer air tight connections with the power cables and be made of or coated with a material that will not oxidise in air, and produce its own high impedance joint in the power lines, such as gold and silver. Rhodium is a poor conductor and does affect the impedance somewhat. There are many designers who use Rhodium plating as it seems to have a positive effect. Our findings suggest that gold plating offers a warmer quality with a fuller sense of space and place, unplated and silver plating a very natural open sound, and rhodium plating a dynamic 'cool' sound with less ambient micro-details. We are talking about small differences here.

2. Shielding of mains cables. It seems logical to use a radio frequency shield over the power cable to prevent it acting like an aerial. However, virtually all audio electronics sold do have some form of RF and EMI filtering in their designs to comply with EU regulations, and mains cable shielding may well cause more problems than it solves. We do not have a yes or no answer here, but some of the best performing mains cables we have tried have no shielding and some do.

3. The constructional design and the insulation around the cable have a big effect on the 'sound' of that cable. Yes, we have found this to be very true. Not all cables are equal - we have tried exotic mains cables with gold-plated super-pure copper, insulated with PTFE and damped with cotton (and with a super-high price tag) that sounds less good than simple tin-plated copper in silicon rubber insulation. You have been warned!

4. Do we need a power conditioner? Not unless you have a particular problem with your mains (particularly clicks and buzzing), or wish to improve your audio or A/V sound to a level beyond what mains cables alone can offer. Excellent power conditioners do work, but they are expensive. They add a further level of conditioning. Cheaper conditioners tend to use cheaply made passive components like chokes, resistors and capacitors that add resistance and inductance in the power supply line that bring as many problems as they solve. We will discuss power conditioners in our part 2 sheet on power supply.

5. If you are unfortunate and live in an area where a high DC voltage is present on your AC mains power line, causing the transformers in your equipment to hum, you may need a DC blocking transformer only, not a power conditioner. This is a specialist component and we can advise on this. Removing the small amount of DC in the mains will improve most audio set ups however. There's usually a small residual DC voltage on the AC power lines. If you are looking for the best sound quality possible, it should be considered.

Suggestions for audio power supply cabling

The DIY or BEST-VALUE approach

A single or double unswitched wall socket with silver-plated contacts for low contact resistance are recommended. They do ensure the lowest impedance solution for UK 3 pin mains plugs – as you cannot get into mains sockets easily to clean them!

Our silicon rubber sheathed cable, fitted with an MS HD Power or (not quite as good) MK 'Tough-plug' and a good quality IEC plug will outperform many far higher priced mains cables.

Our mains cables kits are a best value option. All the items can be bought separately of course if you prefer to combine them with other plugs or cables of your own choice. We also sell the DIY cables as made up Sound Fidelity cables.

Have a dedicated earth spike fitted to your dedicated mains socket. We will discuss this in more detail in part two of this information sheet. This is a most cost effective upgrade one can make to your audio system but it must be undertaken by a qualified electrician.

Manufactured cables

Black Rhodium power cables do in our opinion offer good performance and value. Electronics designer Graham Nalty, who owns and runs the company, has spent decades designing and making cables for audio use and his products are regularly awarded top marks the Hi-Fi press.

ISOL-8 also offer good value shielded power cables that work with and without their power conditioners.

Check out our website www.soundfidelity.co.uk for further information on parts and cables we like and recommend.

Remember – Mains power can kill. Always ask a qualified electrician to help and or test your work if you undertake DIY assembly work.

Sound Fidelity information sheets have been prepared from information available through manufacturers, technical white papers and our own extensive testing. The conclusions drawn are our own opinions and we are not saying the products we do not discuss here are bad or wrong to use, just sharing our experience of the products we have tested.

Lots of claims made by manufacturers cannot easily be checked, and marketing copy is of course far from impartial, so we use our ears to tell us what works and what does not, whenever we can. We are happy to pass on to our customers our views and discoveries, but they are just that – our honest views about what we are hearing, from lots of hours listening and comparing products and accessories.

The difficulty with recommending particular products over others is that we are often looking for different qualities from our systems depending on our own particular taste - but we ALL want to be entertained by our music, and get our home audio systems to entertain us better. That is what we try to offer you.

There are some products and accessories that clearly have a positive impact on sound quality in almost all systems but frustratingly, some audio kit seems to work well in some systems and not in others. It is often a 'balancing act' - all home audio systems are a sum of their parts - upgrade one component and you may highlight a problem elsewhere. We want to help you to get the best from your audio system and hope our information sheets will be of use, offering general background and specific product information in an interesting way..