

Using CleanSweep® AC EMI Filters in Hi-Fi and Pro-Audio Setups

CleanSweep® EMI Filter Summary

CleanSweep® AC EMI filters were developed for industrial applications where the levels of EMI caused by operation of machinery are very high, affecting normal operation of sensitive electronics. Patented CleanSweep® filters provide high-level of attenuation in all modes—common, differential, and, uniquely, in ground. CleanSweep filters are designed to reduce industrial-level EMI down to negligible levels—in residential or studio environment they simply render remaining EMI unmeasurable.



CleanSweep® AC EMI Filter AF Series

Filters or Power Conditioners?

Debates about the need and the benefits of “power conditioners” in audio applications are very much alive. On the subjective side, their benefits are “in the ear of beholder.” Here we address the engineering side of “power conditioning.”

First, the term “power conditioner” is so wide that even a lowly surge protector may claim it. On the opposite end, a complete true power conditioner would use incoming AC power to generate its own clean low-harmonics sinewave with constant voltage and frequency, with absence of any surges or transients, plus added battery-backed operation in case of power sags or blackouts — an extremely expensive and bulky approach suited for life- or mission-critical applications. In absolute majority of cases “power conditioner” simply means EMI filter, perhaps with added helping of a transient surge protector.

CleanSweep® AC EMI filters satisfy both these requirements. They provide exceptional attenuation of EMI from AC power line and ground in all modes. For technically-minded please see our web page on how CleanSweep technology offers unique advantages over conventional filters: <https://www.onfilter.com/real-life-filtering>

CleanSweep® filters also provide unique highly effective transient surge protection. Conventional surge protectors are amplitude-based, allowing spikes up to 440V (in 120V regions) and up to 900V (in 240V regions) to pass through to your equipment. If you are curious, see specification of professional-grade surge protectors (a hint - if a product brochure is long on superlatives but very short on numbers and charts, professional grade it is not). CleanSweep® EMI filters instead treat such transients as EMI regardless of amplitude, and effectively suppress them down to significantly lower levels—typically below 10V. See details here: <https://www.onfilter.com/protection-from-transients> It is still a good idea to use a professional-grade surge protector **before** the filter to mitigate long-term surges, however rare they may be.

About OnFILTER

OnFILTER, a California, USA company, was started in 2010 with the goal of addressing a growing issue of electromagnetic interference in industrial, scientific, and medical environments. Increased level of automation brings in more sources of EMI into environment, while similarly growing use of sensitive electronics is accompanied by its malfunction due to EMI. OnFILTER manufactures a broad line of EMI control products: AC EMI filters, DC EMI filters, ground EMI filters, servo motor and variable frequency drive (VFD) filters, data filters and others. Company provides filters to large and small companies, government entities, and, as it happens, Hi-Fi enthusiasts. OnFILTER designs and manufacturers all of its products in USA and ships them around the world where we have international distributors to support our products locally. You can reach us at info@onfilter.com

What Makes CleanSweep® Filters Well-Suited for Audio?

Indeed, what specific parameters may be important for audio? First, the filter shall not introduce any degradation to the sound—no one wants the cure that is worse than the problem itself. What kind of degradation a poorly-designed filter may introduce? Here are just a few:

Distortion

Harmonic distortion can be caused by high impedance of power supply. During sound peaks, especially at lower frequencies, the amplifier draws the most current from its power supply, and, correspondingly, from the AC mains. What happens if output impedance of your entire AC power chain is too high? The higher the supply current, the higher the voltage drop on that power chain, and the lower the AC voltage supplied to your amplifier. The result is harmonic distortion of sound (Fig. 1). The biggest power consumption is during loud sounds at low frequencies—it takes more energy to move the diaphragm of a subwoofer than that of a twitter (we are omitting here and elsewhere a lot of back story—[contact us](#) if you want details). In case of high output impedance of your AC supply the waveform of that bass sound would be inevitably distorted, creating a lot of harmonics. What else would be distorted? All other sounds during such overload—this is called intermodulation distortion (Fig. 2).

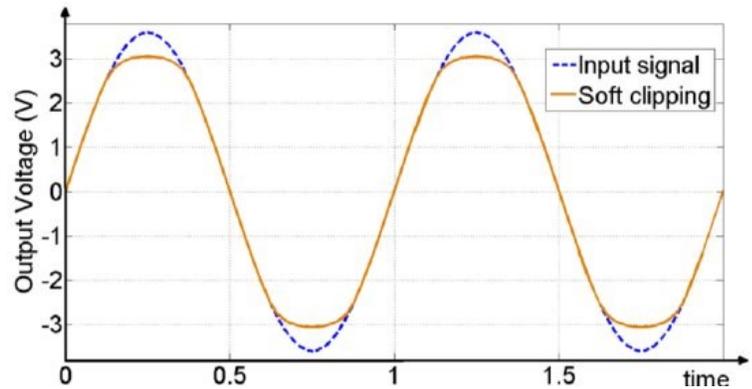


Figure 1. Soft clipping
Source: *Journal of Low Power Electronics*

Why would your AC power have high output impedance? The usual suspects are too thin of a gage of wires in the wall from the distribution box to your outlet, and don't forget the resistance of all the twist-cap connections on the way—every connection eventually oxidized and adds resistance.

If you add a filter or a transformer, depending on their construction this may add significant impedance. Many filters use less-costly underrated inductors which present higher-than-necessary impedance.

Transformers inherently have high impedance, unless they use substantial core and large-gage wire which makes them quite large and expensive. Both of the above may introduce core saturation at current peaks since their design is often defined by cost constraints.

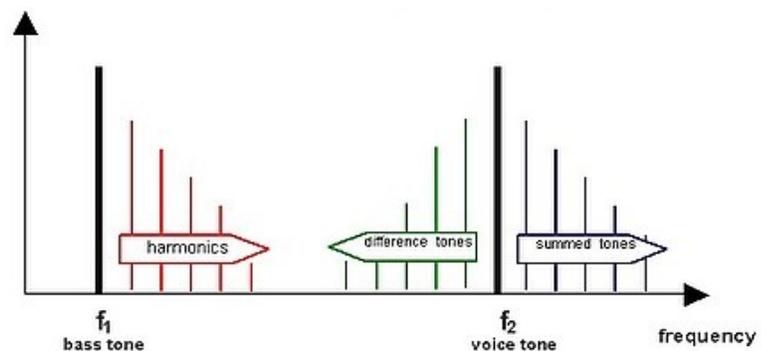


Figure 2. Intermodulation Distortion
Source: *Klippel*

CleanSweep® filters, on the contrary, are not transformer-based. The cores of its inductors are large enough not to saturate, and the thick gage employed in the filter's construction offers low resistance. Proprietary architecture and know-how provide buffering for current peaks—all resulting in low dynamic impedance.

Filtering Properties

What are the typical properties of the EMI signals in most environments? The biggest noise pollutants are omnipresent switched-mode power supplies (SMPS), solar panel inverters, which are, in essence, SMPS, and pulse-driven motors, such as variable frequency drives (VFD) present in many appliances—refrigerators, pumps, washers, dryers, and alike. The spectrum of SMPS typically lies anywhere between 40kHz and 150kHz; VFD—from a few kHz to tens of kHz. This means that the filter has to be most effective at these frequencies. Many quality regular filters do a

decent job at the higher end (MHz) of the spectrum, but at lower end (kHz) where it is actually needed, their performance gets worse, and some may even amplify noise at these frequencies. CleanSweep® EMI filters excel at that critical lower-end of the spectrum providing very high degree of attenuation—see the filters’ datasheets at <https://www.onfilter.com/ac-power-line-emi-filters>

Ground Noise

Ground connects all equipment in the facility, or in house, propagating EMI leaked by noisy equipment throughout the entire premises. Patented CleanSweep® AC EMI filters uniquely include highly-effective ground filtering blocking EMI on the overall ground circuit from reaching your setup.

This has certain importance in connecting filter in your setup: all your components must be connected AFTER the filter, otherwise one stray component bypassing the filters may bring EMI pollution on the overall ground pass the filtering into your setup.

One Filter for All

EMI filter for audio is supposed to protect the entire setup from noise on power line and ground. It is a given that none of your components are noise generators by themselves—there is no need to protect, say, a CD player from EMI coming from a turntable. CleanSweep® filters have just one heavily-rated filter section for your entire setup. Dual outlet in case of U.S. NEMA type is just a matter of convenience—it does not indicate two filters inside. Both outlets are equal and are connected inside.

Connecting the Filter

Figure 3 shows the most typical audio setup containing an amplifier, and a number of components. Our recommendation is to plug your power amplifier in one of the outlets, and a quality power strip in another outlet. Make sure that that power strip does not have any filtering as it may interfere with CleanSweep® performance. Connect all your components into that power strip.

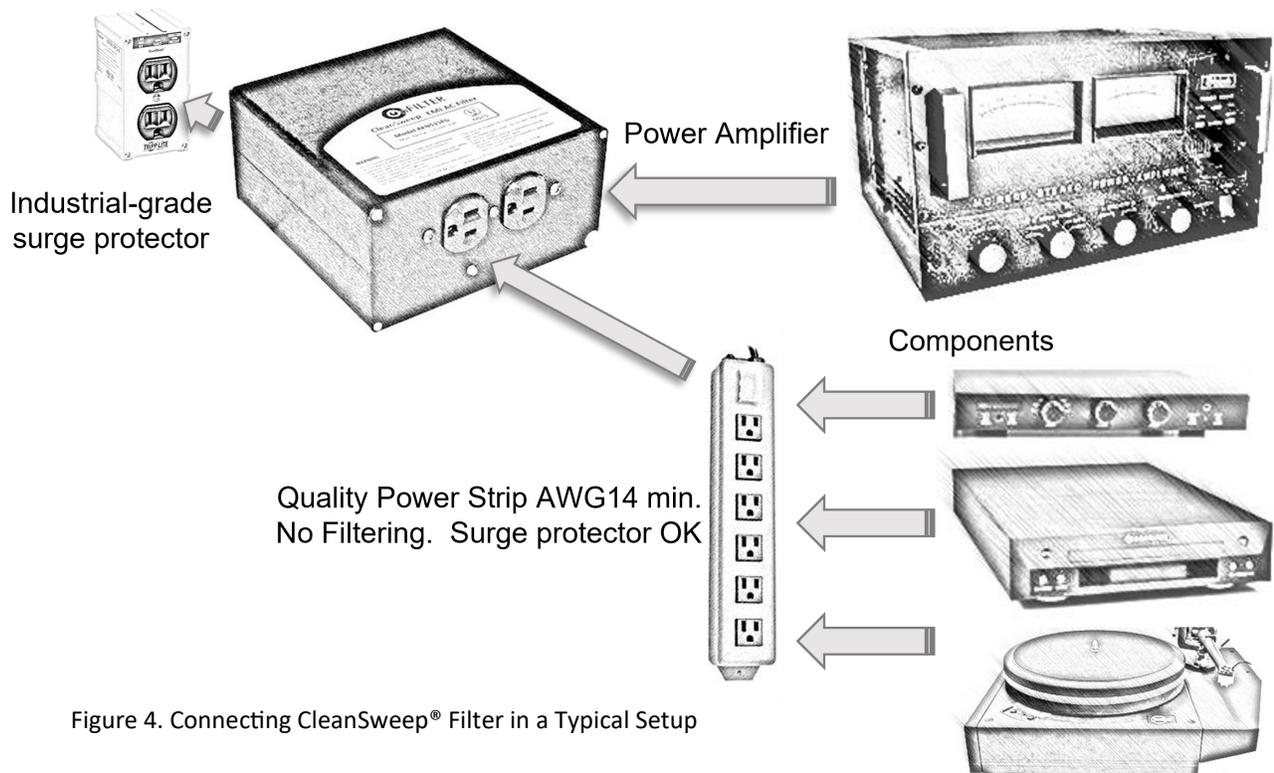
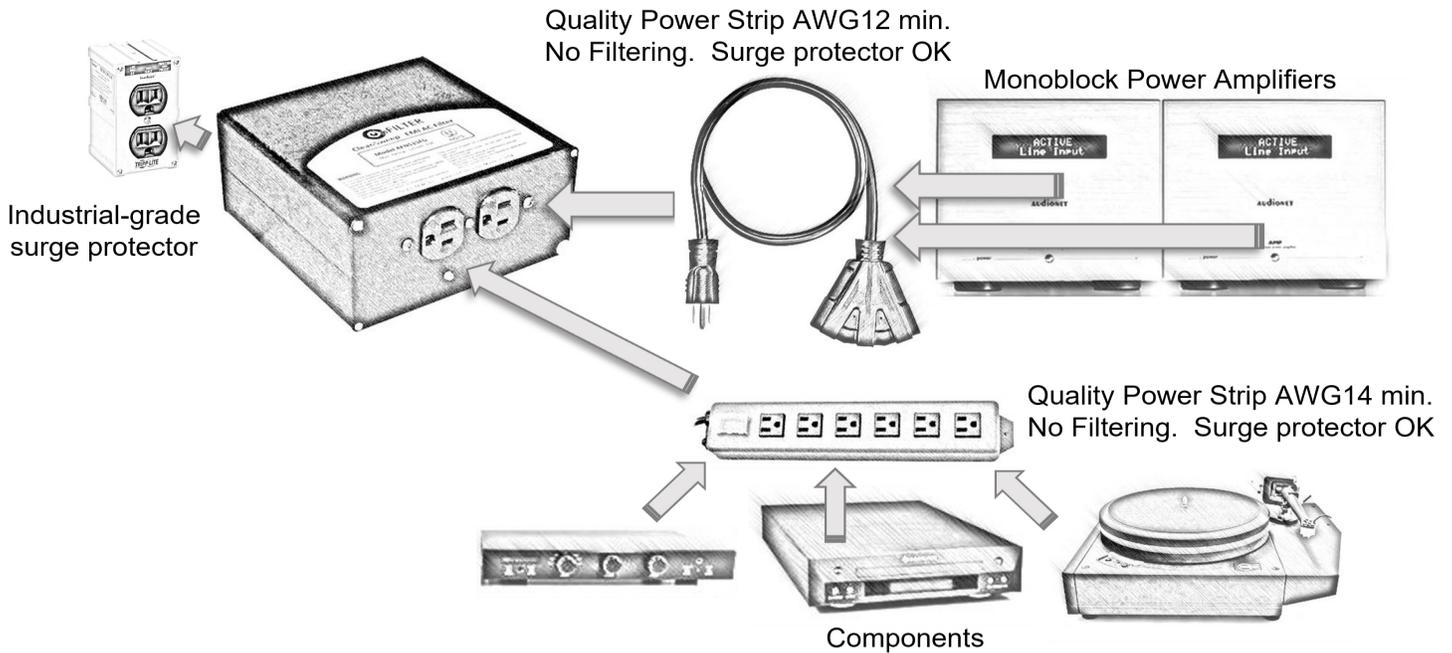


Figure 4. Connecting CleanSweep® Filter in a Typical Setup

What if you have two mono amplifiers? In this case we recommend the setup of Figure 4. Procure heavy-duty good quality AWG12 power extender—usually found in pro hardware stores. Plug it into one of the outlets, and your two amplifiers into the outlets of that extender. The components are connected in the same way as in Figure 3.



What Do Users of CleanSweep® Filters Say:

"Just a quick note to say thank you for the noise filter. The filter has proven to be completely effective in eliminating any of the issues I was experiencing. Thanks again for the excellent filter" (R.B., Canada)

"We installed the filters, did some initial testing, and then did some more extended config and testing. So far we have been rock solid on amp performance, and according to the audio install guys, it seems like we are both getting better raw performance as well as have had the system running without issues longer than it ever ran previously."
Church Sound Installation, Chicago

We compared the AP Series 3A AC EMI Filter and the TrippLite power conditioner and the Furman AC-215A. The AP Series 3A AC EMI Filter was the only one that eliminated the effects of the IEC test (Electrical Fast Transients and Bursts) on the device under test. Congrats (D.H., Medical Equipment Manufacturer)

"Just a quick note to say thank you for the noise filter. The filter has proven to be completely effective in eliminating any of the issues I was experiencing. So effective in fact that I cannot even hear the amplifiers' toroidals in operation at idle or under any listening levels with my ear on the amps' case. The amps' noise floor is now utterly silent, and it seems to be running slightly cooler as well. Thanks again for the excellent filter" (R.B., Canada)

"I think you build an excellent product that the audiophile industry ought to know about" K.F