Reducing Interference from UPS with OnFILTER CleanSweep® AC EMI Filters

OnFILTER's plug-and-play CleanSweep® AC EMI filters provide reduction of EMI generated by uninterruptable power supplies (UPS) and protect against switchover transients. They are very effective in suppressing EMI in broad range in real-life applications, not just in laboratory environment.

Figure 1. CleanSweep® AC EMI Filter

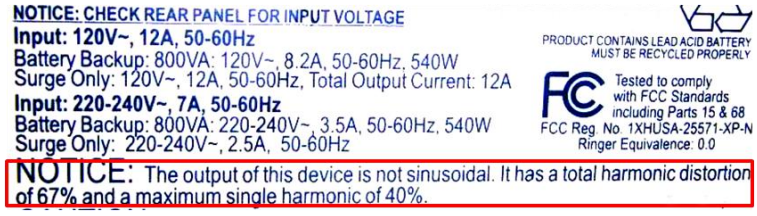
Uninterruptable Power Supplies (UPS) and EMI

UPS are essentially switched mode power supplies with a battery. When AC power is available, the mains voltage is converted to a lower DC voltage which charges the internal battery. Once mains power is either lost or is of unacceptable quality, a second internal switched mode power supply takes the battery voltage and tries to reconstructs equivalent of mains voltage to supply to the load which lasts as long as the battery voltage is sufficient, or until proper AC mains power returns. There are two main problem with using UPS: the reconstructed voltage is typically not a sinewave; and also during switchover between AC and battery power is often accompanied by a strong surge.

Signal at the Output of UPS

Reconstruction of an acceptable sinewave is an expensive endeavour for a number of technical reasons. Not many users are willing to pay premium for a sinewave output and even fewer manufacturers are willing to add expenses to a product which the customers buy anyway. Lets examine what a typical brand-name UPS generates.

Here is a note on a back label of a popular UPS:



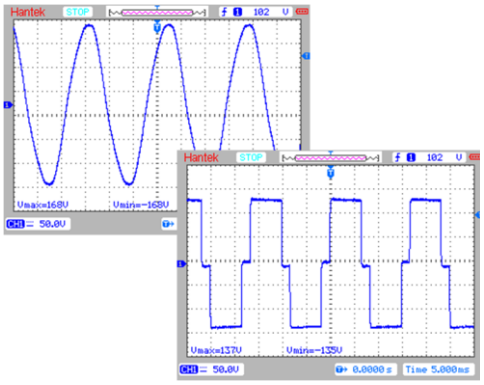


Figure 2. Mains waveform and output of UPS

As seen, even by design the waveform is far from sinewave. Figure 2 shows typical AC mains waveform which is close to a sinewave and the output of a regular UPS in absence of mains power. Not only this waveform if far removed from a sinewave and has plenty of harmonics of 50/60Hz, the sharp edges of pulses cause significant amount of high-frequency noise on output power line, or conducted electromagnecit interference (EMI). The waveform of high-frequency noise (with mains signal removed for clarity) generated by such reconstructed voltage is shown in Figure 3. As seen, the highest levels of noise are correlated with the pulse edges of the output power. Noise over 7V peak can easily interfere with normal operation of sensitive equipment rendering the whole purpose of UPS in maintaining normal operation irrelevant.

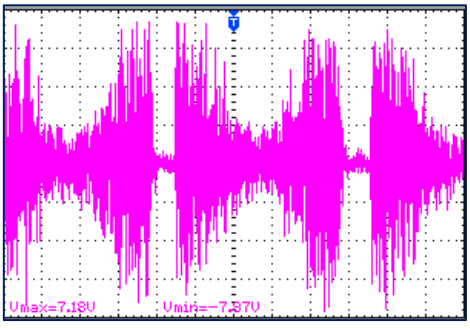


Figure 3. High frequency noise after UPS

Lets now examine more closely what happens at the edges of the output pulses. Figure 4 shows the output waveform of UPS and accompanying high-frequency spikes as well as just the spikes with UPS output high voltage removed for clarity. Synchronization between the spikes and the edges of power output is clearly seen. These spikes provide the basis for noise shown in Figure 3. Of course, reputable UPS have built-in EMI filters, however they are effective only in specialized tests for electromagnetic compliance in the laboratory, not in real-life applications - see OnFILTER Advantage paper.

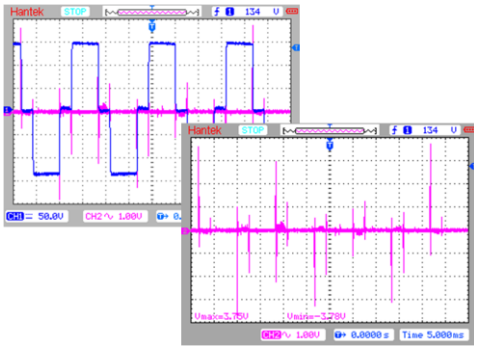


Figure 4. Output of UPS and EMI. On second image high voltage output removed for clarity

Switchover can cause very strong transients (Figure 5 - red arrow) which conventional surge protectors cannot suppress.

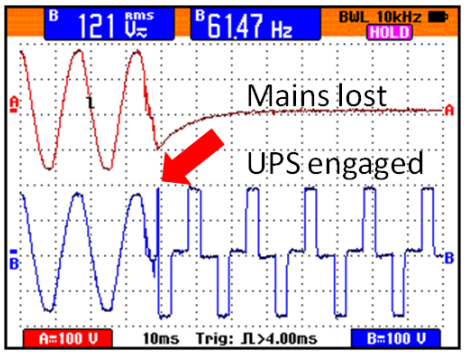


Figure 5. Switchover to UPS
Source: Repeater-Builder

Strong high-frequency spikes can cause interference with normal operation of sensitive equipment, such as computers, data banks, instrumentation, industrial control, medical equipment and alike. EMI raises overall noise level in equipment as well as induces false signals leading to data loss and data misinterpretation. Even transient signals as low as 0.5V are capable of damaging sensitive components by electrical overstress (EOS) per IPC-A-610.

CleanSweep® EMI Filters

OnFILTER's CleanSweep® AC EMI filters are designed to suppress electromagnetic interference on power lines and ground in real-life applications. CleanSweep® AC EMI filters connected at the output of UPS substantially reduce EMI and transients by modifying sharp edges of reconstructed AC mains waveform and by suppressing switchover spikes. Figure 6 shows rising edges of output pulse from UPS - original and modified by CleanSweep® AC EMI filter. Figure 7 shows how CleanSweep® EMI filter reduces overall EMI at the output of UPS. Figure 8 shows basic connection of CleanSweep® AC EMI filter with UPS.

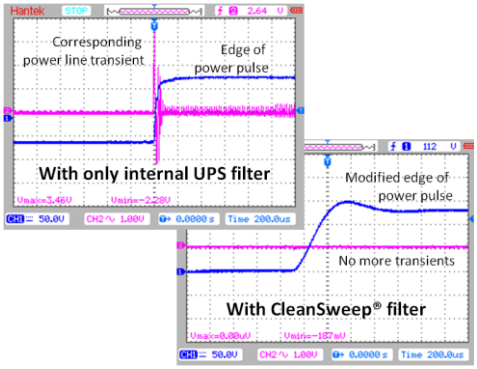


Figure 6. Modified edge of reconstructed waveform and associated EMI

Conclusion

OnFILTER's CleanSweep® EMI filters virtually eliminate EMI and switchover spikes at the output of UPS. They are easy to install and do not require maintenance. Please visit our web site for complete line of CleanSweep® AC EMI filters. Contact us at info@onfilter.com.

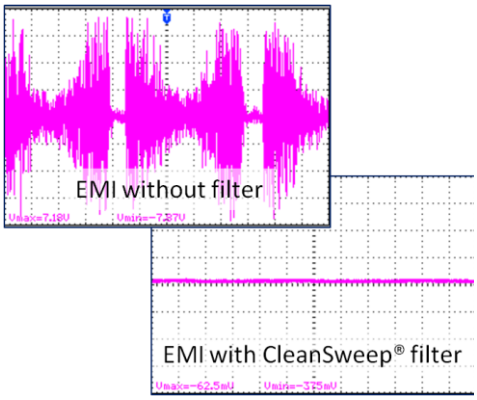


Figure 7. Reduced EMI by using CleanSweep® AC EMI filter

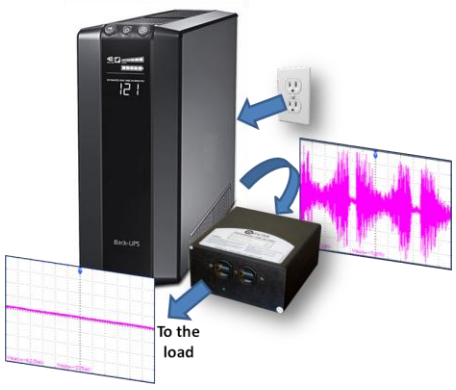


Figure 8. Connect CleanSweep® EMI filter at the output of UPS before your load