Uninterruptable Power Supplies (UPS) and Electromagnetic Interference (EMI)
Background

- UPS (uninterruptable power supplies) provide power to your equipment during AC power outage or when certain parameters of power quality fall below acceptable limits.
- UPS are found in production and test equipment, servers, data banks and elsewhere.
- In the ideal case UPS would provide to your equipment the same voltage as the regular mains power.
- This, however, is far from reality.
Is it Only 50/60Hz or Something Else?

- Many things are not what they appear to be
- UPS (Uninterruptible Power Supply) is supposed to provide voltage similar to the one from the AC outlet
- Well, not necessarily sinewave and not necessarily clean...
- When AC mains are OK, UPS acts as pass-through device providing sinewave output to the load as shown to the right
- When AC mains voltage is not adequate, UPS generates its own “mains” which is far from sinewave

**NOTICE:** CHECK REAR PANEL FOR INPUT VOLTAGE

Input: 120V~, 12A, 50-60Hz
Battery Backup: 800VA, 120V~, 8.2A, 50-60Hz, 540W
Surge Only: 120V~, 12A, 50-60Hz, Total Output Current: 12A
Input: 220-240V~, 7A, 50-60Hz
Battery Backup: 800VA, 220-240V~, 3.5A, 50-60Hz, 540W
Surge Only: 220-240V~, 2.5A, 50-60Hz

**NOTICE:** The output of this device is not sinusoidal. It has a total harmonic distortion of 67% and a maximum single harmonic of 40%.
UPS: Anything but Sinewave

Output voltage from different UPS
Distorted Waveform is a Source of EMI

- Rapid voltage edges (otherwise known as dV/dt) contain significant high-frequency energy.
- These screenshots show transient spikes on AC line at the output of a typical UPS that are synchronized with the reconstructed AC output.
OnFILTER’ CleanSweep® EMI Filter at the Output of UPS

- Any CleanSweep® EMI filter suppresses high-frequency transients to a negligible level
- Simply connect CleanSweep® EMI filter at the output of your UPS and then connect your equipment to the output of the filter

Yellow – reconstructed AC at the output of UPS after CleanSweep® filter
Green – greatly reduced transients at the output
UPS with and without CleanSweep® EMI Filter - Comparison

UPS Output without Filter

UPS Output with Filter

Yellow – reconstructed AC at the output of UPS
Green – noise at the output
Measuring Output of UPS Without Filter

1. Use fully-charged UPS
2. Connect equipment as shown
3. Make sure UPS is on
4. Observe approximate sinewave on oscilloscope
5. Unplug power cord of UPS itself from the AC outlet
6. Observe distorted waveform at the output of UPS and increased noise

Connect all to battery backup output

Connect load if desired. Load should not generate noise, i.e. incandescent light or heater

100:1 Scope Probe. Connect between Live and Neutral

Battery-powered oscilloscope. Do not plug into AC mains!
Measuring Output of UPS With Filter

1. Use fully-charged UPS
2. Connect equipment as shown
3. Make sure UPS is on
4. Unplug power cord of UPS itself from the AC outlet
5. Observe still distorted waveform at the output of UPS but significantly reduced noise

MSN01 or MSN12 Power Line EMI Adapter. Set to differential mode (MSN01) or measure between Live and Neutral (MSN12)

Connect to battery backup output

CleanSweep® AC EMI Filter

Connect load if desired. Load should not generate noise, i.e. incandescent light or heater

100:1 Scope Probe. Connect between Live and Neutral

Battery-powered oscilloscope. Do not plug into AC mains!
Contact Information

Vladimir Kraz
OnFILTER, Inc.
+1.831.824.4052
vkraz@onfilter.com
www.onfilter.com

CleanSweep® Family of Power Line EMI Filters

AF Series up to 20A 250VAC
AP Series 3A 250VAC
AL Series 10A 250VAC
AF Series 30A 250VAC