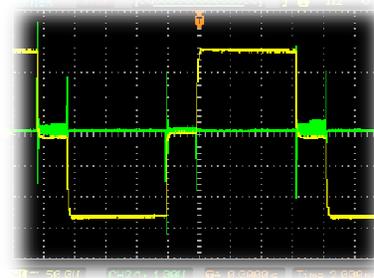




Uninterruptable Power Supplies (UPS) and Electromagnetic Interference (EMI)

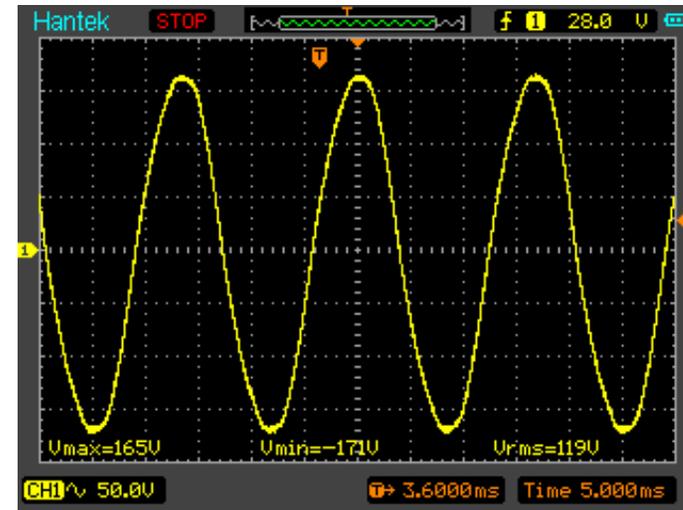


Background

- 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

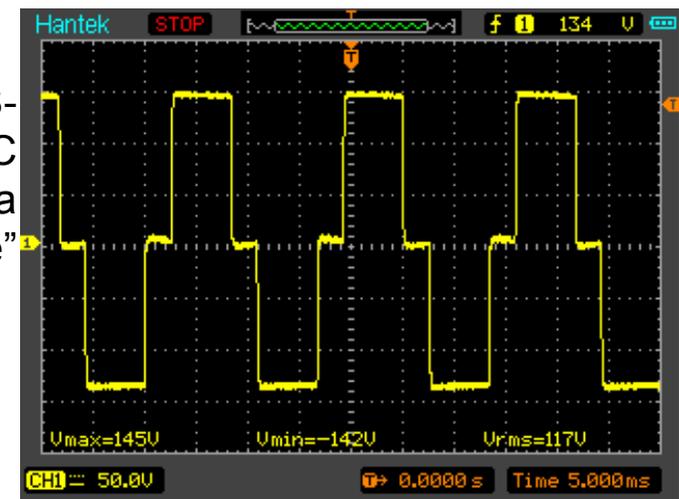
Is it Only 50/60Hz or Something Else?

- 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



UPS output when adequate AC voltage is present

UPS-generated AC – not quite a “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

www.apc.com



PRODUCT CONTAINS LEAD ACID BATTERY
MUST BE RECYCLED PROPERLY



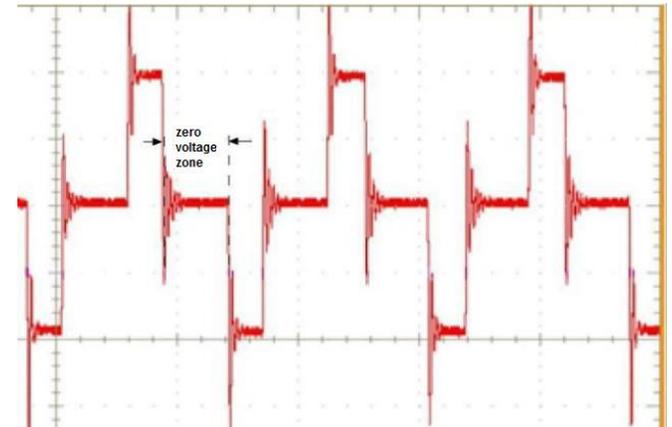
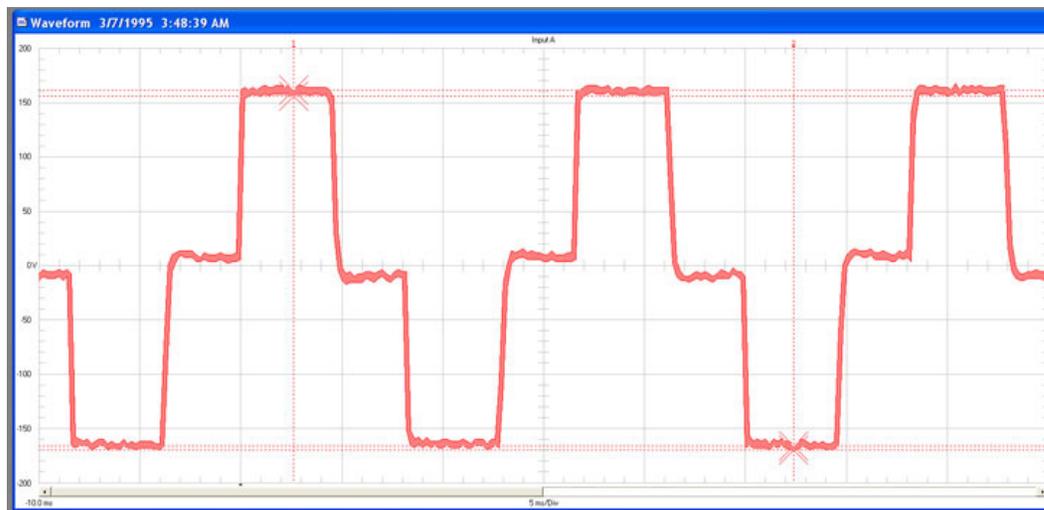
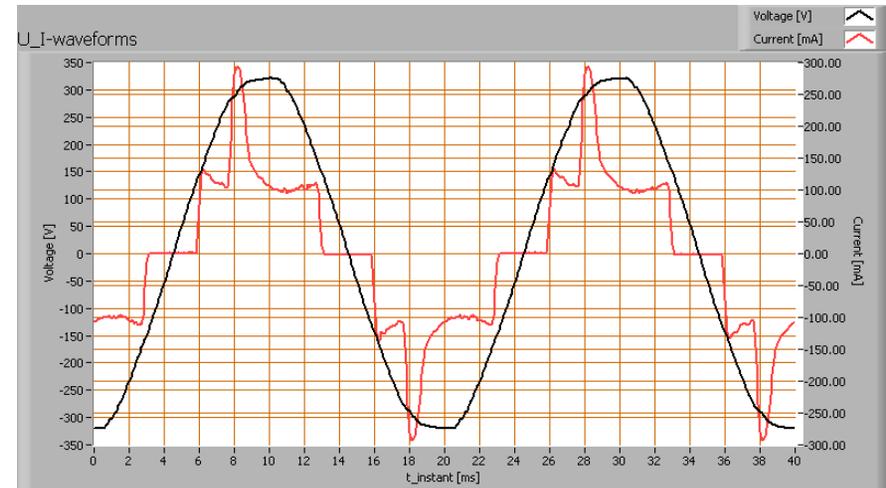
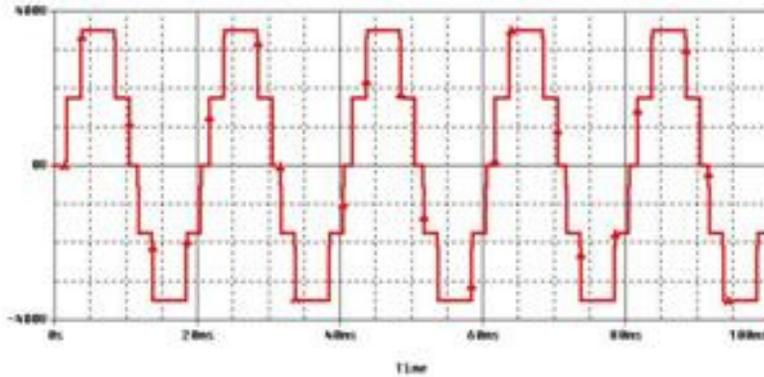
Tested to comply
with FCC Standards
including Parts 15 & 68
FCC Reg. No. 1XHUSA-25571-XP-N
Ringer Equivalence: 0.0

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



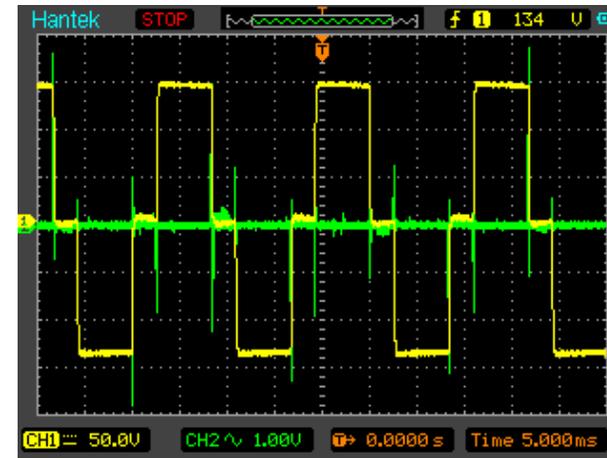
UPS: Anything but Sinewave

Output voltage from different UPS



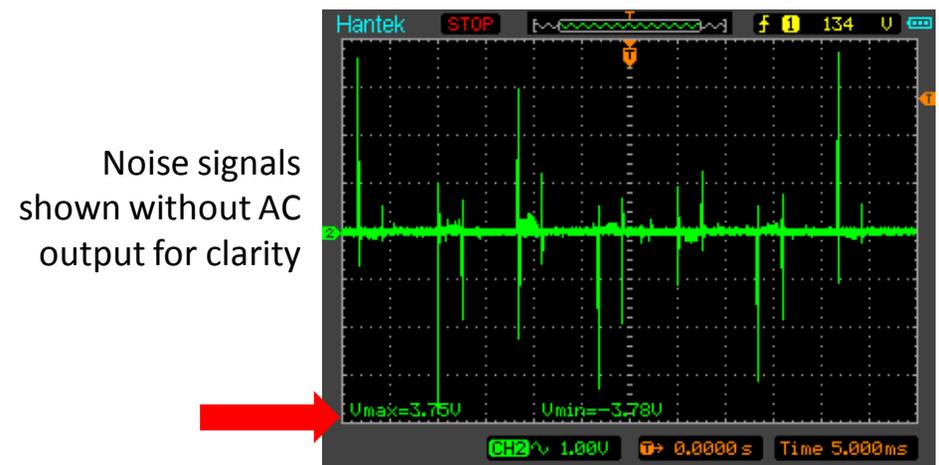
Distorted Waveform is a Source of EMI

- 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



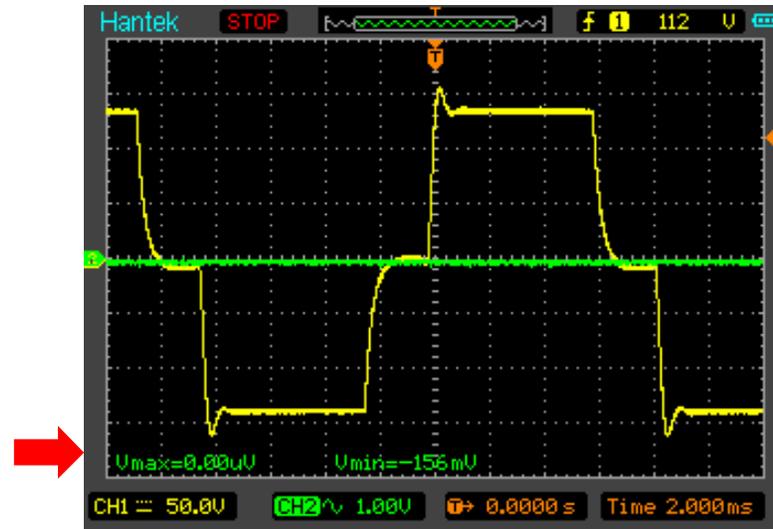
Yellow – reconstructed AC at the output of UPS

Green – noise at the output (synchronized with the 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

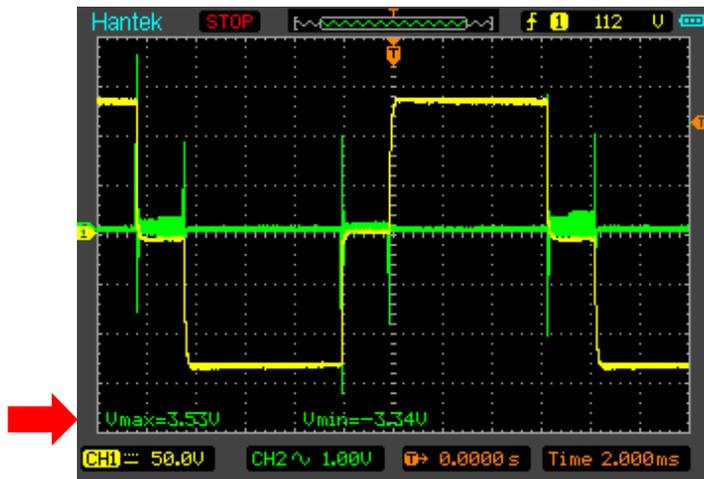
Green – greatly reduced transients at the output



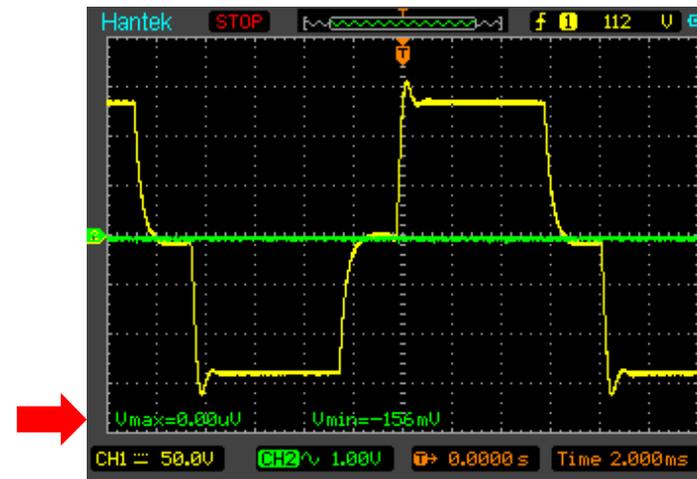
©2014 OnFILTER, Inc.

UPS with and without CleanSweep® EMI Filter - Comparison

UPS Output without Filter

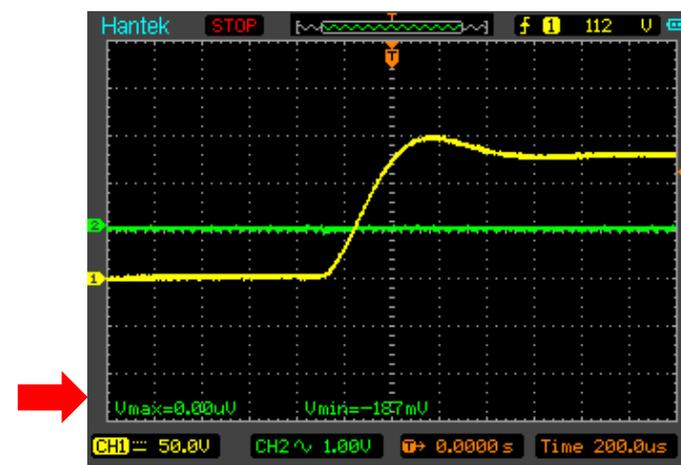
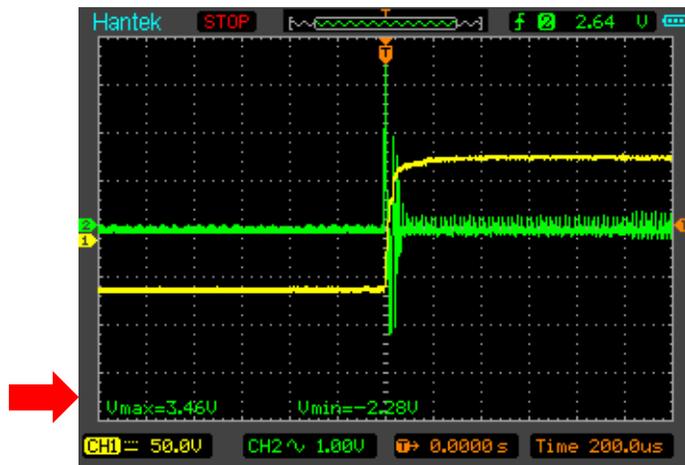


UPS Output with Filter



Yellow – reconstructed AC at the output of UPS

Green – noise at the output



Measuring Output of UPS Without Filter



Connect all to battery backup output

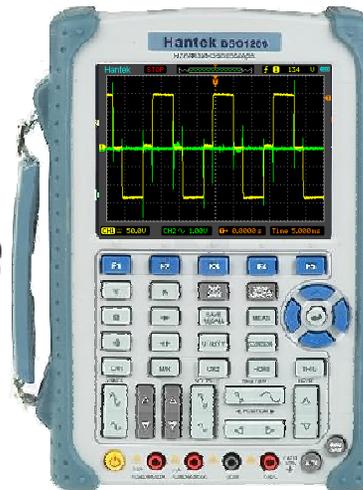


Connect load if desired. Load should not generate noise, i.e. incandescent light or heater

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



100:1 Scope Probe. Connect between Live and Neutral



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

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

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



Connect to battery backup output



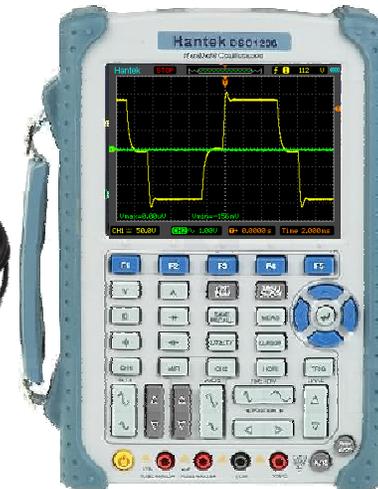
CleanSweep®
AC EMI Filter

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



100:1 Scope
Probe. Connect
between Live and
Neutral

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



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



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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