

RPS-501 / RPS-251 Regenerative Power Supply

TECHNICAL WHITE PAPER

Introduction

The RPS-501 and RPS-251 are 100% fully linear power conversion regenerative power supplies specifically engineered to drive high-fidelity (HiFi) front-end electronics, including network streamers, media players, DACs, and preamplifiers. By isolating these sensitive components from main line interference, these units deliver an ultra-low-noise power solution tailored for high-performance audio systems.

The Modern Power Quality Problem

While high-fidelity front-end equipment typically operates at low power consumption, its performance is heavily reliant on an exceptionally clean AC power source to deliver optimal signal resolution and audio quality. Unfortunately, modern mains power is significantly more polluted compared to previous decades. This degradation is driven by the rapid proliferation of household electrical appliances—most notably those utilizing switching power supplies and widespread LED lighting—which inject substantial electrical noise back into the main power lines.

1. Incoming Line Distortion (Laboratory Analysis)

Laboratory measurements highlight the severe distortion present on typical incoming power lines. As shown in the oscilloscope capture below, the standard 50Hz sine wave exhibits clipped, flattened peaks rather than a smooth, ideal curve.



Figure 1: Distorted incoming 50Hz mains supply waveform captured via laboratory oscilloscope.

2. FFT Spectral Analysis

A Fast Fourier Transform (FFT) analysis reveals that the incoming supply is heavily contaminated across the entire frequency spectrum up to 100 kHz. Beyond the fundamental 50Hz frequency, a dense array of unwanted harmonic frequencies and high-frequency noise spikes are present.

Incoming Total Harmonic Distortion (THD): 2.86%

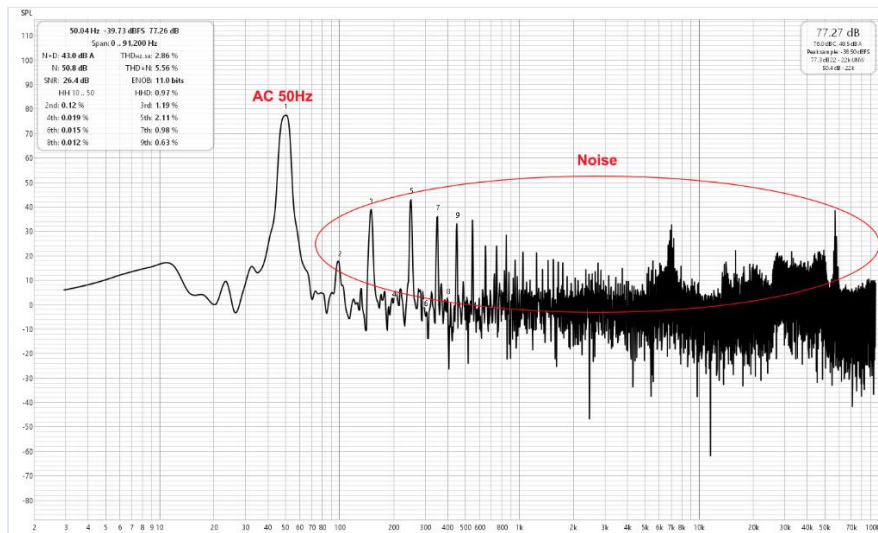


Figure 2: FFT spectrum of the incoming line showing extensive harmonic pollution up to 100 kHz.

When this polluted power enters high-fidelity gear, it directly manifests as an elevated noise floor at the loudspeaker output, masking micro-details and degrading spatial imaging.

The Regenerative Solution: Switching vs. Linear Conversion

To combat mains pollution, manufacturers often deploy regenerative power supplies to reconstruct a fresh AC signal from scratch. However, the engineering execution dictates the final audio performance:

- **Switching Regenerative Supplies:** To minimize chassis size and manufacturing weight, many brands opt for high-frequency switching conversion topologies. Unfortunately, these switching mechanisms induce high-frequency noise and compress system dynamics. Furthermore, this switching noise back-feeds into the incoming AC line, polluting adjacent system components—such as power amplifiers—connected to the same electrical circuit.
- **Fully Linear Regenerative Supplies (RPS Approach):** A 100% fully linear conversion path remains the gold standard for generating pure, unadulterated electricity. While this topology requires a substantial physical footprint and heavy premium magnetics, it completely eliminates the artifacts of switching noise, preserving unrestricted dynamics and an absolute black background.

Performance Validation: RPS Output Results

When the distorted mains power is processed through the RPS-501 or RPS-251, the AC waveform is completely reconstructed into a pure, highly stabilized sine wave.

1. Reconstructed Output Waveforms

The RPS units feature selectable output frequencies (50Hz or 60Hz), allowing users to optimize their front-end equipment performance regardless of regional mains standards.



Figure 3: Reconstructed 50Hz output waveform from the RPS series, displaying a smooth, symmetrical sine wave.



Figure 4: Reconstructed 60Hz clean output waveform.

2. Output FFT Spectral Analysis

The reconstructed output shows a drastic drop in both low-order harmonics and wideband high-frequency noise floor when compared to the raw mains supply. The entire spectrum up to 100 kHz is swept clean of spurious interference.

Output Total Harmonic Distortion (THD): 0.1% (An improvement of over 28x compared to incoming mains).

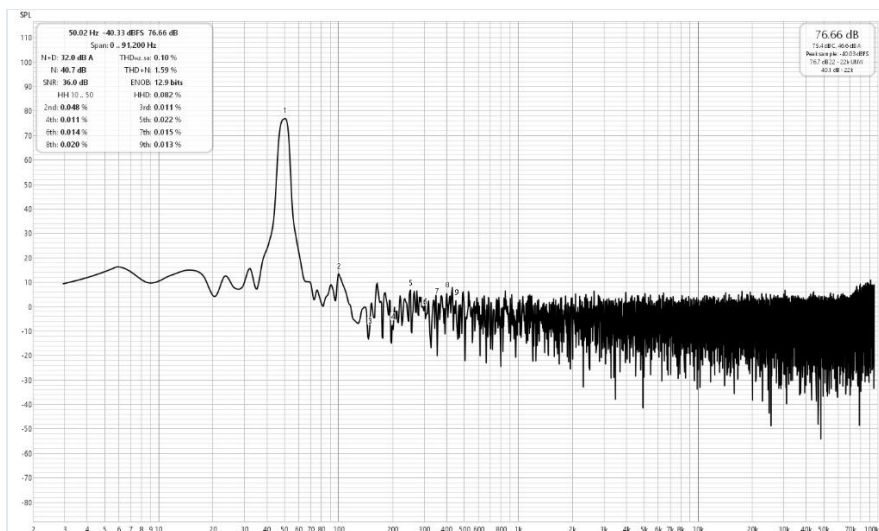


Figure 5: Swept output spectrum at 50Hz, showing pristine harmonic suppression.

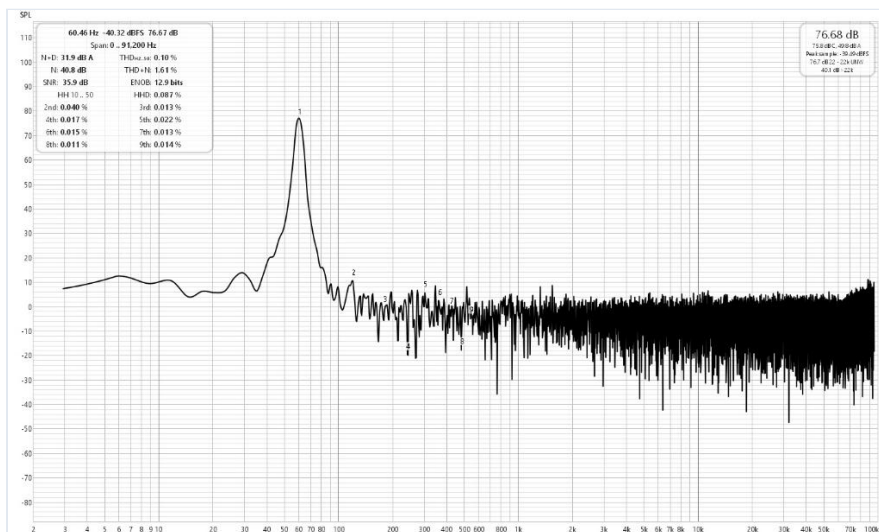


Figure 6: Swept output spectrum at 60Hz, maintaining identical ultra-low distortion metrics.

Technical Specifications

The RPS series incorporates a microprocessor-controlled core paired with heavy-duty physical protections to ensure stable, audiophile-grade power delivery.

Feature / Parameter	RPS-501 Specification	RPS-251 Specification
Input Voltage Range	198VAC – 260VAC, 50–60Hz	198VAC – 260VAC, 50–60Hz
Input Voltage Management	8-step automatic continuous monitoring	8-step automatic continuous monitoring
Input Connection	MPS IEC Inlet	MPS IEC Inlet
Output Voltage	230VAC ± 5%	230VAC ± 5%
Continuous Power Output	500W max	250W max
Output Frequency Options	Selectable 50 Hz / 60 Hz	Selectable 50 Hz / 60 Hz
Output Waveform	Pure Sine Wave	Pure Sine Wave
Total Harmonic Distortion (THD)	Better than 0.2% (0.1% typ.)	Better than 0.2% (0.1% typ.)
Output Receptacles	4x MPS American Standard Duplex	4x MPS American Standard Duplex
System Controls	Microprocessor Soft-Start & Zero-Crossing Detection	Microprocessor Soft-Start & Zero-Crossing Detection
Safety Hardware	Mini Circuit Breaker (MCB) Over-Current Protection	Mini Circuit Breaker (MCB) Over-Current Protection
Smart Protections	Microprocessor Over/Under Voltage & Over-Current Monitor	Microprocessor Over/Under Voltage & Over-Current Monitor
Chassis Dimensions	432mm × 318mm × 120mm (W × D × H)	432mm × 318mm × 120mm (W × D × H)
Net Weight	23 kg	17 kg