

Decimate Hum with PAT-4 Replacement Transformer Kit

The Problem

We live in a world where 60 Hertz power is everywhere. An unavoidable part of this is magnetic and electric fields at 60 Hz and its harmonics. Those fields and harmonics cause hum in your PAT-4 preamp, particularly in high gain circuits like the phono preamp.

If you've been an updatemydynaco customer for a while, you've already cut the hum that comes through the power supply rails to amplifier PCB's. You did this when you installed the PAT4PWR Electronically regulated power supply.

Still, there's another significant source of hum inside the preamp...the power transformer. Magnetic fields generated in the power transformer couple into the PCB traces. They also couple into the wires to and from the input/output RCA connectors, switches, and controls.

Under the theory that "no good deed goes unpunished", phono hum may be more noticeable after you've installed PAT4LP, the phono update kit. It drops the rushing sound component of the phono noise enough to unmask more of the hum that was previously covered up.

One way to reduce the hum is to move the power transformer out of the PAT-4. You can put it in a separate box and run shielded cable into the PAT-4. Even though it works well at reducing hum, it's kind of a messy solution. There is a better way!

The Better Way

Even though the original Dynaco transformer is encased in metal, it still broadcasts a lot of stray magnetic fields into the PAT-4's circuits. It's just difficult to contain the magnetic fields from a classic E-I transformer. What's needed is a transformer type that naturally, by its geometry, contains the stray magnetic fields. A toroidal transformer.

I've had a custom toroidal transformer made to replace the original PAT-4 power transformer. Toroids are well known for their well-contained magnetic fields. If you keep the magnetic field inside the transformer, then you cut the coupling to the preamp's circuits that causes hum.

The new PAT4X kit contains everything you need to dramatically drop the hum generated inside a PAT-4:

- Custom toroidal transformer (suitable for 120 or 240 Volt wiring)
- Transformer mounting plate, shield, and hardware for easy mounting
- Updated capacitor (recommended for PAT4PWR compatibility)
- A great set of directions to make installation easy.

The Results

Here are some before and after spectrum analysis plots that show the improvement from the PAT4X upgrade. For all of these plots, there is no signal. The spectral lines you see are the hum and harmonics measured at the preamp outputs with the volume control set to maximum, and all tone controls set to flat.

The first two spectrum analysis plots have the selector set to Tuner, with shorting plugs on the tuner inputs. Both plots show the left channel.

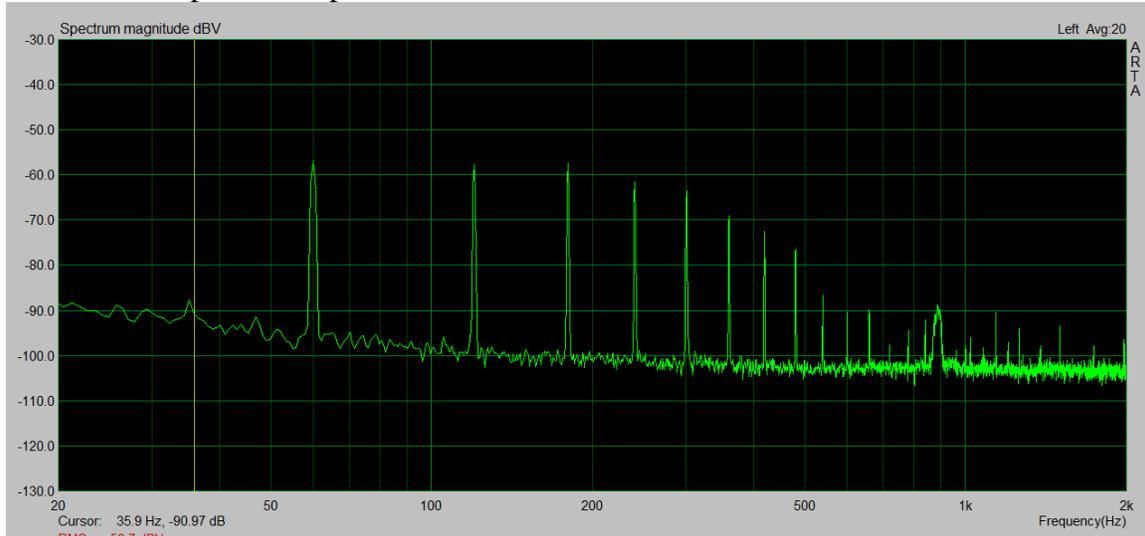


Figure 1 – hum spectrum with original transformer arrangement, tuner input, left channel, shorted

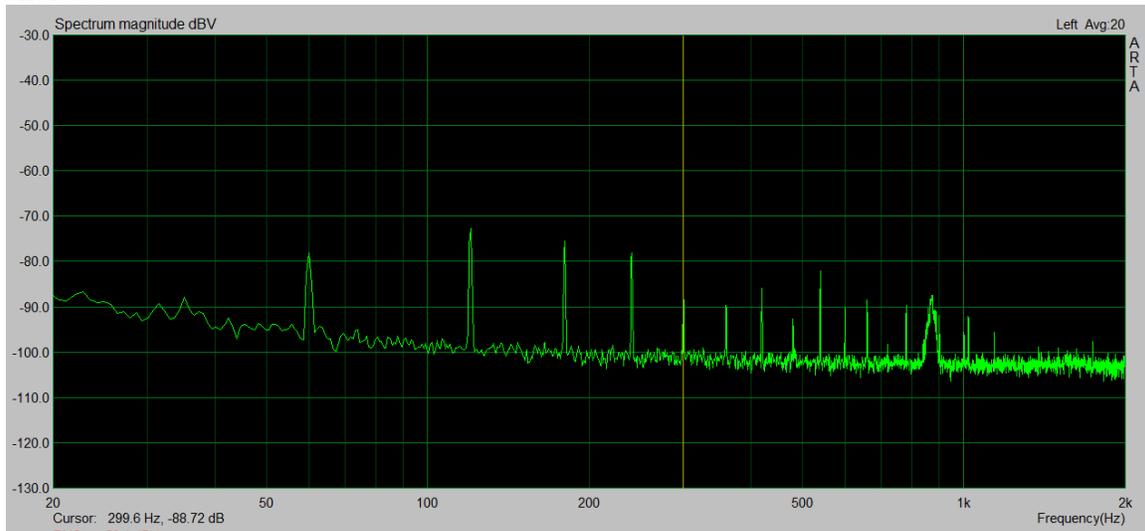


Figure 2- hum spectrum with toroidal transformer, tuner input, left channel, shorted

Comparing the two plots, you'll see that the toroidal transformer arrangement is at least 10 dB better than the original transformer. In many harmonics, it is 15 or 20 dB better. 10 dB is a factor of 3X voltage. 20 dB is a factor of 10X voltage. This is truly a significant difference!

In the next two plots, everything is the same as before. The difference is that the phono input are shorted and the selector in the phono position,

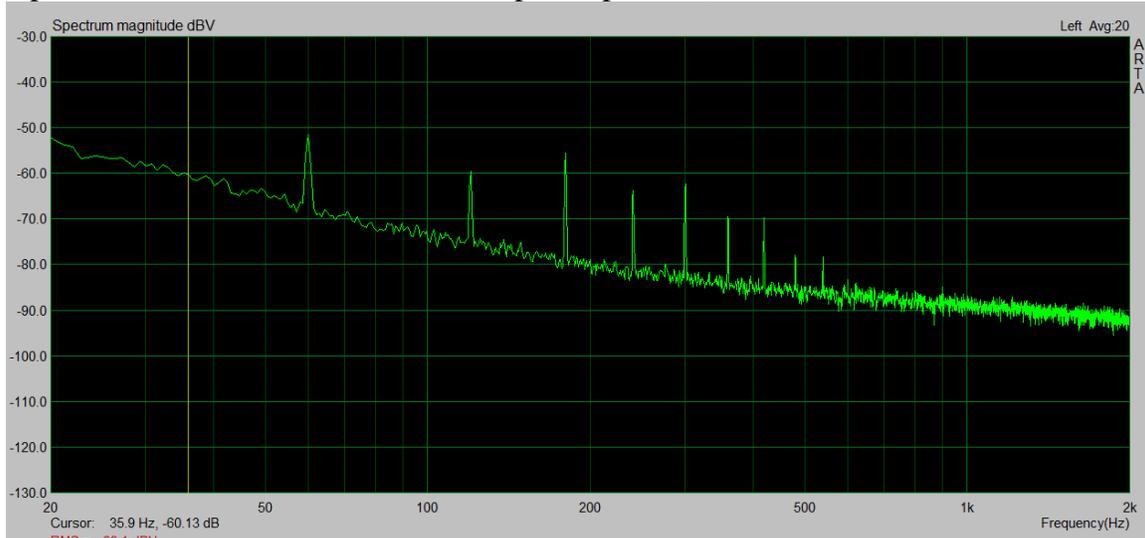


Figure 3 – hum spectrum with original transformer, phono input, left channel, shorted

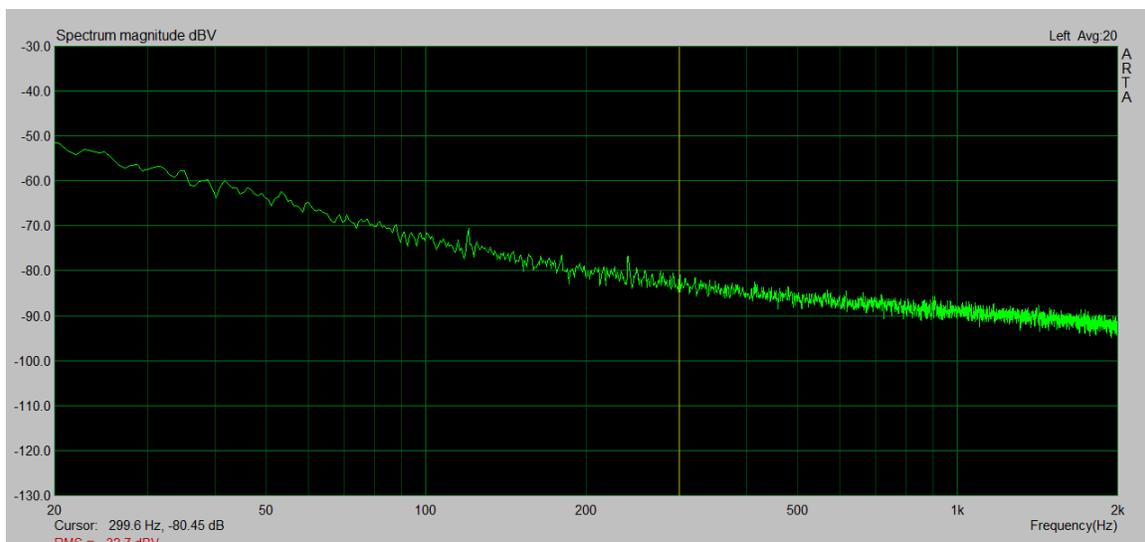


Figure 4 – hum spectrum with toroidal transformer, phono input, left channel, shorted

Once again, comparing Figure 3 and 4, there is a dramatic difference. Note that the rising noise floor in these two figures is due to the relatively large gain at low frequencies of the phono preamplifier.

Phono Noise with a Phono Cartridge

A phono input that isn't shorted, and has a real phono cartridge connected, will have more noise than shown in both Figures 3 and 4. The general noise shape will be higher owing to input noise current and the impedance of the phono cartridge. The hum harmonics, even in the best case, will be higher as there's typically 3 to 6 feet of cable

between the cartridge and the preamp input. That length is still susceptible to external 60 Hz fields and their harmonics.

In order to see the internal preamp noise, and not noise pickup from the cartridge, these measurements used a phono cartridge housed in a steel box. A cartridge mounted in a tone-arm would not have this much shielding, and thus the hum pickup in that case might not show as great a difference as Figures 5 and 6 do.

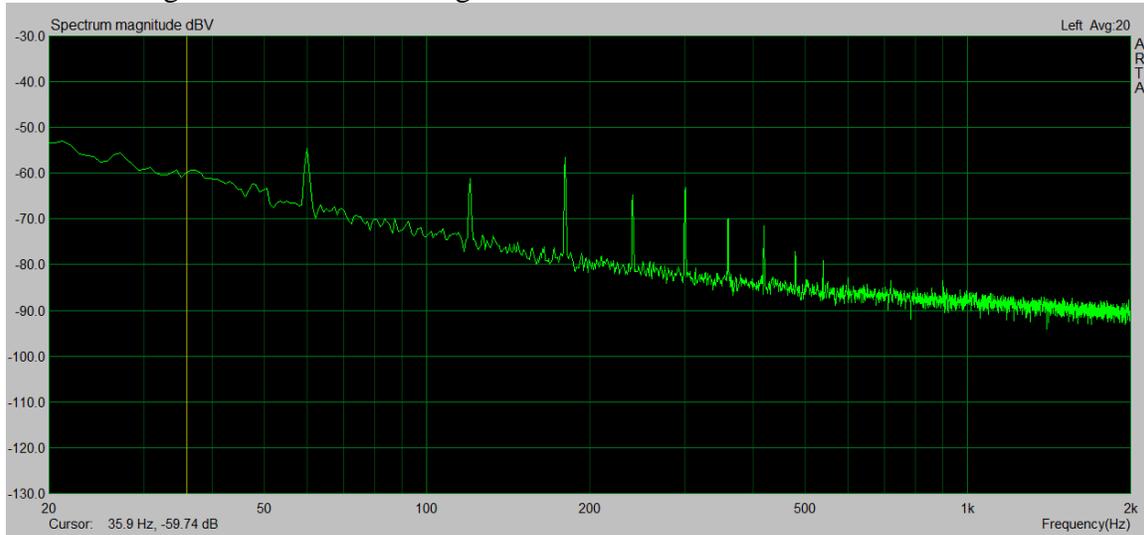


Figure 5 - hum spectrum with original transformer, phono input, left channel, phono cartridge

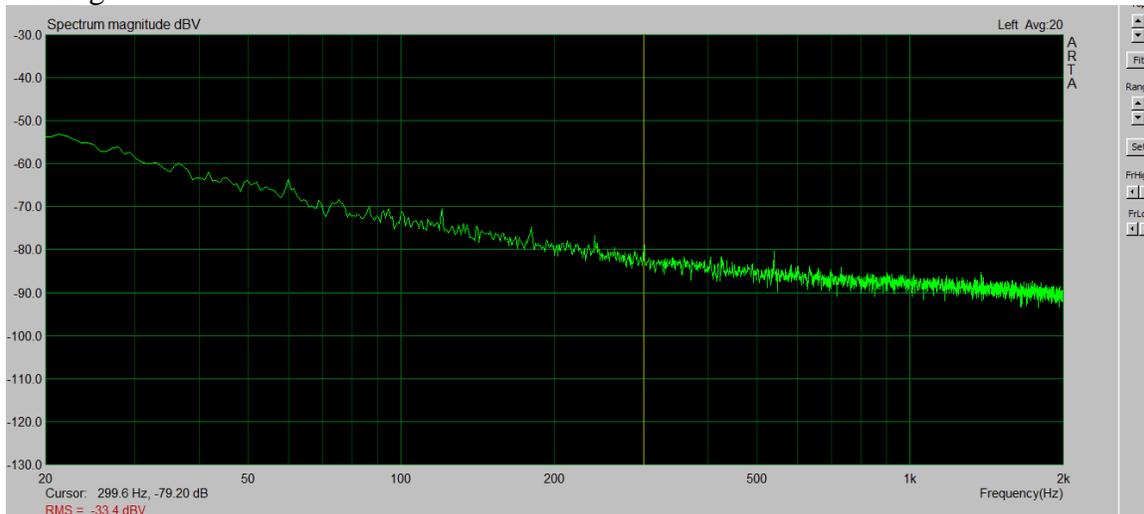


Figure 6 - hum spectrum with toroidal transformer, phono input, left channel, phono cartridge

Test Notes

These tests were made on a PAT-4 that had the following enhancements:

1. PAT4PWR electronic power supply
2. DRD4 Distortion Reducer
3. PAT4LP Phono Preamp Upgrade Kit
4. P4LSRC line stage Replacement components