Adjusting the Servo Board

Tools needed:

Trimpot adjustment screwdriver
Digital multimeter with a millivolt AC range or ranges
REW and a sound card or DAC, calibrated with REW

Adjust RV1, RV3 and RV4 full counter-clockwise (minimum). They come full clockwise (maximum). Don't turn on the amp with them set that way.

With no amplifier connected, connect an AC volt meter between TP1 "SIGNAL" test point and ground.

Power up the servo board and apply a 60Hz, 0.2Vrms signal to the "RIGHT INPUT" terminals. The meter should read 0.1Vac. Adjust the REW output until it does read approximately 0.1Vac.

Move the meter to the "OUTPUT TO AMPLIFIER" terminals. Adjust RV4, "SIGNAL", until the voltage is about 5Vac. Adjust the RV3, "FEEDBACK OUT", clockwise to approximately the same number of turns you used on RV4, "SIGNAL". It doesn't need to be perfect - it will get adjusted later.

Power down the amplifier then the servo board.

Using a "Y" cable, run the input 60Hz signal to the servo board's "RIGHT INPUT" terminals, as above, and to the power amplifier's input. Connect one voice coil to the amplifier output, making absolutely certain the polarity is correct. Run another set of wires from the second voice coil to the "VOICE COIL INPUT" on the servo board, again making sure the polarity is correct. The positive terminal on "VOICE COIL INPUT" is marked with a "+". These feedback wires may be as small as 28ga.

Power up the servo board, then the amplifier.

The amplifier will be driving the sub woofer at about 1/10 power (loud).

With the meter on the servo board's TP2, "FB" test point, adjust RV1, "FEEDBACK IN", clockwise until the meter reads 0.1V.

Move the meter back to the "OUTPUT TO AMPLIFIER" terminals.

There is no telling what it will read. Something between 0.25Vac and 12Vac. Adjust RV3, "FEEDBACK OUT", clockwise a bit. The goal is to get the voltage as low as possible. It won't go to zero. A hint: when you get it as low as you can, turn RV3 counter-clockwise until the meter just reads 0.1Vac higher than the low point. Keep in mind that the gain of the error amp is 50, so a very little tweak of the knob makes a huge difference in the output voltage.

Turn the amplifier off, then the servo board.

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Now the scary part. Take the 60Hz signal off of the amplifier input, and run a cable from "OUTPUT TO AMPLIFIER" terminals to the power amp input. Leave the 60Hz signal connected to the servo board's "RIGHT INPUT" terminals. Turn the amplifier on, and the servo board. If the woofer begins to go stop to stop, and makes a noise like a Harley (called "motorboating"), turn it all off, and reverse the feedback wires. Turn it on again, and it should make the same sound that it did when the amplifier was hooked directly to the 60Hz signal. Just a 60Hz sinewave. Fairly loud.

Now it is time to tweak the feedback. It is done by adjusting RV3, "FEEDBACK OUT", to get the quietest sound. It won't be like it was before, with the voltage going smoothly up and down. It will be smooth going down, until you go the slightest bit too far. Then it will be like dropping off a cliff. Harley time again. Put your heart back in your chest and turn RV3 back the other way until it stops the "motorboating" and you're done.

You can iteratively adjust the tuning by then adjusting RV4, "SIGNAL", clockwise a tiny bit to make the sound a little louder, then adjust RV3, "FEEDBACK OUT", until the volume is the same as it was before you adjusted RV4 up. You can keep doing this until turning RV3 up results in motorboating. Turn it back counter-clockwise until it stops motorboating, and call it done.

Each iteration of tuning increases the control the servo has over the cone. When it motorboats, the feedback has exceeded the signal, and the overall feedback of the circuit becomes positive, causing oscillation. Try not to leave it in that mode too long. It is driving the amplifier probably 12 times harder than full volume. Not good for amplifiers or speakers. The sub woofer driver is only good for 40W, 80W maximum. Don't use a 300W amplifier to drive it - try to keep it below 100W.

If you overdrive the sub, it will create a situation where the signal is more than the feedback, and the amplifier will be driven with 50x the difference. This will cause a knocking sound at the frequency it is trying to reproduce, and is a sign you're trying to get too much out of it. It is also a sign that you are exceeding the mechanical limits of the driver. You need to turn down the input level from the active crossover, or limit the lower frequency of the input signal. This thing isn't magic. It can't violate the laws of physics.

NOTES:

1. The 60Hz tone is because most meters are calibrated for RMS values at 60Hz. Other frequencies yield different results.

2. Typical servo gain is 50 to 200. I chose 50, since I could tune it manually. As the gain increases, the sensitivity of the adjustments increases, making it difficult to tune.

3. You can start tuning by using 51k feedback resistors (R11 & R12) for the coarse adjustment with a gain of 25, then swap out the 51k resistors with 100k resistors for a gain of 48, or 220k resistors for a gain of 100, to finish the calibration. Just remember it gets harder to tune as the gain goes up.

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4. The amplifier you end up using in the sub woofer is the one you MUST tune with. It is part of the feedback circuit, and changing it changes the settings. The settings adjust the amount of feedback for a given input voltage. That relationship changes with the gain of the power amp.

5. DO NOT TRIP OVER THE FEEDBACK WIRES, or unplug them in any way. The amp will go full tilt into the sub woofer driver, and likely melt the voice coil.

SCHEMATIC DIAGRAM