Andy Szabo Techtalk: Ultrasonic Bias Supply

When, Why and How

When was Ultrasonic introduced?

For Spectra loudspeakers manufactured after approximately December 1, 1988, the line-powered bias voltage power supply was upgraded to a low-voltage-input, ultrasonic oscillator bias supply.

Why Ultrasonic

The purpose of the bias supply is to provide the 5000 volts necessary for the electrostat's operation. The output of the old style supply was dependent on fluctuations in line voltage and loudspeaker component tolerances. No means was available to adjust this supply for a specific operating point.

The output of the new power supply is regulated, meaning that it is insensitive to fluctuations in line voltage. Furthermore, a factory adjustment is made, based on the actual measured high voltage, for a specific predetermined operating point. The result is a more stable and accurate stereo image, consistent tonal quality, and performance that does not vary over time due to line voltage fluctuations.

How does Ultrasonic work

This circuit accepts power input at low voltage (12 - 15 volts) from a conventional wall transformer. See Wall Transformers. The transformer, though small in size, is more than adequate for the minimal power requirements of this circuit. (The bias supply consumes about as much power as a small night light!) The input voltage is rectified, filtered, and regulated to supply stable and consistent power for the oscillator circuit.

The oscillator consists of a power operational amplifier (op-amp), a small handful of resistors and capacitors, and a special air-core step-up transformer. The circuit is self-oscillating at the resonant frequency of the transformer, around 27 kHz. (Hence the term, "ultrasonic".) The effective step-up ratio of the transformer is about 10 times greater than would be expected from its turns ratio, due to the effects of leakage inductance ring-up. The output of the transformer is about 750 volts AC, which feeds a conventional voltage quintupler to create the approximately 5000 volts DC necessary for biasing the electrostatic element.

A trimmer potentiometer, labeled "HV ADJUST", controls the voltage output of the regulator. The advantage of this arrangement is that all variations in the oscillator, transformer, and voltage quintupler are compensated, since the trimmer is adjusted for a specific measured high voltage output. It is for this reason that no attempt should be made to adjust the trimmer without an appropriate high voltage meter. See: Ultrasonic Bias Power Supply Adjustment.

Wall transformers

There exists some confusion over the wall transformer required for the Ultrasonic Bias Power Supply used on the Spectra Series. This is not surprising, as Acoustat did use various wall transformers, depending on vendor supply, and when they were built. The earliest supplies used a 12 volt AC transformer, and later supplies used a 15 volt AC transformer. I don't recall that Acoustat ever used a wall transformer with a DC output. They were always 12 - 15 volts AC, with the 15-volt model used more predominately. The 15-volt supply provided better regulation under low line conditions.

The schematic of the 2200/3300 interface shows the interface wired for 15 VAC input. Note the 470-ohm resistor in series with the zener diode. This resistor is a correct value for 15 VAC input. If you use a 12 VAC transformer, this resistor is 100 ohms.

If you have an older speaker with 12-volt AC transformers, there is no need to upgrade to the 15-volt AC transformers as long as everything is functioning normally.

If the wall transformer needs to replaced, and you are not sure of the required voltage, check the value of the above mentioned resistor. The replacement transformer should have a current output of at least 150 mA. More information on the wall transformers can be found at Available Parts

Adjustment

Measurement and adjustment of the high voltage bias power supply is vital to the proper operation of the speaker. If an imbalance in playing volume is noted, or any modifications or repairs have been made, the bias power supply should be measured and adjusted if required. Two methods of measurement are provided.

- This procedure requires specialized equipment and electronic skills. DO NOT attempt this procedure if you are unfamiliar with safe operating practices around high voltage (+5000-volts DC)
- Do not be concerned about the exact voltage measurements. Due to variable loading effects of different meters, it is impossible to accurately measure the output of the supply. What is important is that both speakers are adjusted to read the same voltage using the same meter
- This procedure requires that the interface be disconnected from both the speaker and amplifier. Do not plug in the wall transformer until told to do so
- Location '5KV' is the point (used for method #1 only) for measurement of the 5000 volt power supply. Location '5KV' is the circuit pad next to the "+5 KV" label located at the center of the large printed circuit board
- It is vital that the circuit board be properly installed within the metal chassis before attempting any measurement or adjustment of the bias voltage. The close proximity of the metal chassis affects the operation of the circuit, and erroneous results will be obtained if the circuit board is not in its final and proper position.

Method 1 (Preferred)

Using a high impedance, 1000:1 high voltage probe, and digital voltmeter, connect the ground lead of the probe to chassis ground (at the solder lug attaching the white wire to the chassis). Apply power via the appropriate wall transformer, and allow the system to stabilize for several minutes. Connect the hot lead of the probe to location '5KV'. Adjust the trimmer potentiometer on the PC board until the probe reads approximately 4.3 volts DC.

Method 2 (Alternate)

Using a 10 megohm input impedance digital voltmeter, connect the ground (black) lead of the meter to chassis ground (at the solder lug attaching the white wire to the chassis). Apply power via the appropriate wall transformer, and allow the system to stabilize for several minutes. Connect the hot (red) lead of the meter to the red pin-plug terminal (where the panel connections are normally made). DO NOT CONNECT THIS TYPE OF METER TO LOCATION '5KV'. Adjust the trimmer potentiometer on the PC board until the probe reads approximately 75 volts DC. This reading will correspond to an actual 5000 volts, but the measurement is greatly reduced due to the voltage divider effect of the power supply and voltmeter.