Vacuum Tube Audio Amplifier

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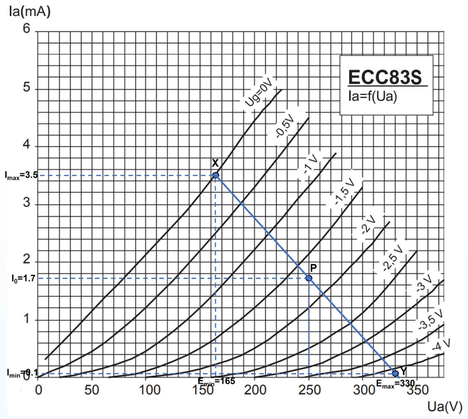
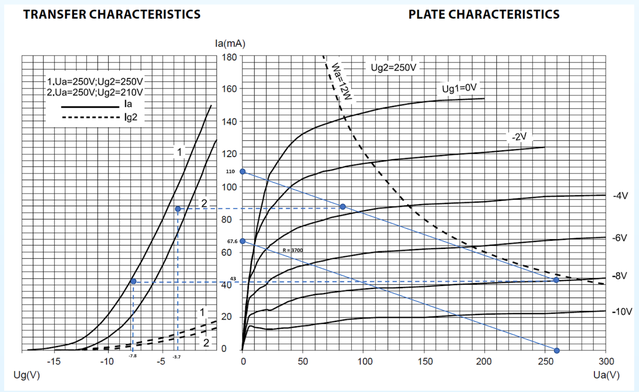
Objectives

- ❑ Single-ended class A mono-block amplifier
- ❑ 20Hz-20kHz bandpass frequency response with no attenuation
- ❑ Minimum of 5W power output with a magnitude of 30dB gain
- ❑ Less than 5% total harmonic distortion

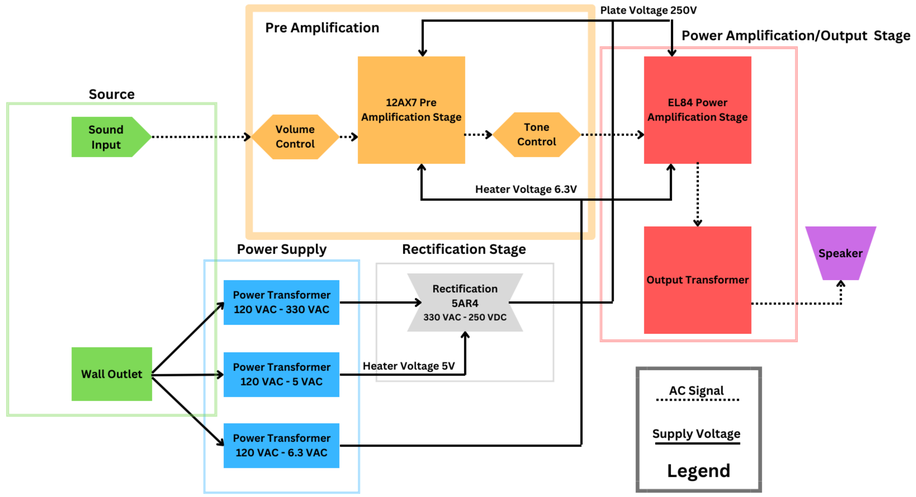
Methodology



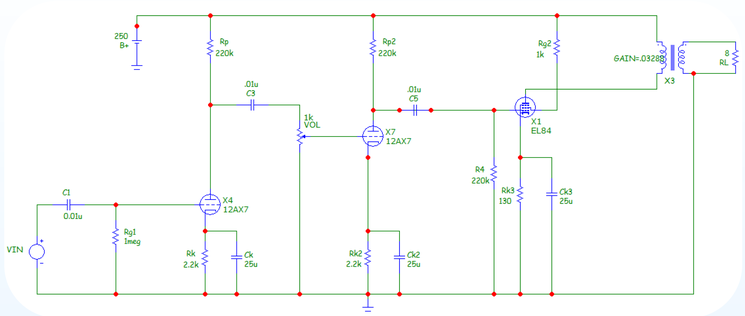
The two characteristic curves show the quiescent points for the 12AX7 and EL84 tubes. These were selected to provide maximum amplification while operating in the linear region for low distortion. The load lines were calculated based on the typical operating voltages of each tube and were used to determine biasing resistances.



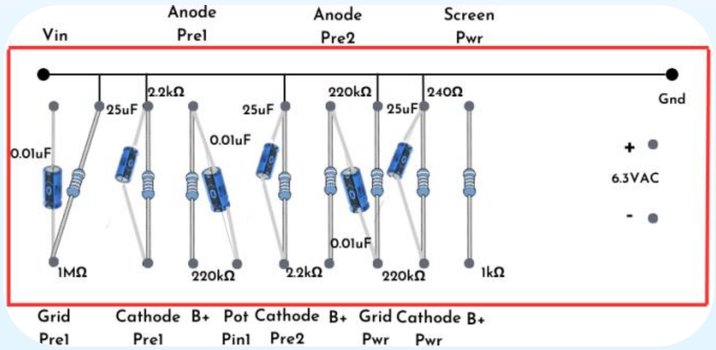
System Block Diagram



Design



This design is centered around a twin triode 12AX7 preamplification tube and an EL84 power amplification tube. The design includes various features such as a grid-stopper resistor for additional filtering, as well as a volume control that enables the user to easily interact with the device. We can see the transformation of the circuit from its schematic layout to its physical layout by comparing the adjacent vertical images.

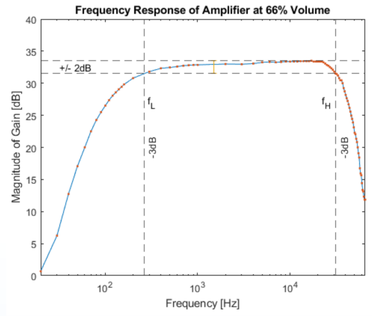


Results

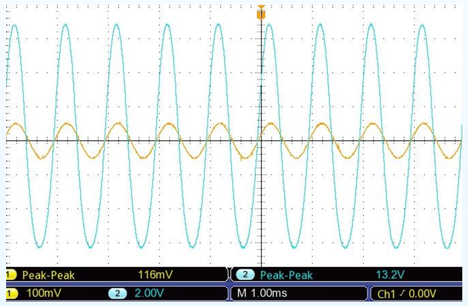
DC Bias Voltages

	Simulated (V)	Measured (V)
12AX7 Anodes	127	125/125
12AX7 Cathodes	1.23	1.134/1.126
El84 Anode	250	247
EL84 Screen	249	247
EL84 Cathode	7.5	7.7

The DC bias voltages were measured to ensure the circuit was constructed/functioning properly with no bad connections.



The frequency response of the amplifier has a passband of 260Hz - 31kHz. The amplifier has a maximum voltage gain of approximately 114 with an output magnitude of 41dB.



Discussion

- ❑ Simulation software was unpredictable, not always reliable, and unexplored
- ❑ Overestimation of an achievable circuit that could be fully completed promptly
- ❑ The lead times and construction of the amplifier chassis were more tedious than anticipated
- ❑ 240Ω cathode bias resistor of the EL84 was adjusted to 130Ω to further center the bias point along the linear operating region of the tube at the cost of a lower-end frequency response