

SEA-1 – Triple 2A3 Amplifier

General Description

The SEA-1 amplifier is a straightforward single-ended audio power amplifier that delivers about 11 watts, using only medium and low- μ triodes. No negative feedback is used, other than local cathode degeneration. No voltage regulation or semiconductors are used in the design. The sound of the amplifier is characteristic of triodes: smooth and detailed. Despite the lack of feedback, the bass is surprisingly solid. This amplifier has been tested on a variety of speakers, and no incompatibilities have been found, except, of course, the need for relatively efficient speakers (approx. 90 db/watt or better).

The SEA-1 was designed to evaluate the prototypes of the UBT-1 transformers. In order to provide flexibility in testing, the SEA-1 was designed to be used with a separate external power supply. There is no reason why the power supply could not be included on the same chassis as the amplifier, as long as hum-inducing components, such as power transformers, are kept away from the amplifier driver circuits. The supply needs to provide 395 volts DC at 160 ma, and 6.3 volts AC at 1.8 Amps. Filtering is not critical, since filter chokes are incorporated into the amplifier. A surplus Dressen-Barnes model 30180 "Unregulated Power Supply" was used for each channel in the SEA-1 prototypes. A simple capacitor or choke-input power supply, as described in the RCA Receiving Tube Manual or Radiotron Designer's Handbook, can be used.

Note that this amplifier description is intended to aid experienced tube amplifier designers and builders. People with little experience building vacuum tube audio amplifiers should not attempt to build this amplifier based on just this

description. The voltages used in this amplifier are lethal! Precautions for working on high voltage equipment must be followed.

Measurements:

Frequency Response: 10 Hz to 44.5 KHz (-3db at 1W)

Output power and Harmonic Distortion: see graph below

Sensitivity: 22 db (to 8 ohm tap)

Damping Factor: 3.5

All measurements were made into a low-inductance 8 ohm resistor connected to the 8 ohm output tap.

Circuit Operation

Choke-capacitor filters are used for both the output and driver stages. Separating the power supply filtering this way reduces feedback from the output to the driver, and helps insure the highest possible B+ voltage to driver tube V2. Locating the filter chokes on the amplifier chassis instead of the power supply helps isolate the amplifier from external noise. Every electrolytic capacitor is paralleled with a film capacitor. R20 is a bleeder resistor to help drain the filter capacitors when powered-down.

The input stage is a conventional resistance-coupled amplifier using the octal 6J5 or 6C5. The metal version is preferred here, due to the electrical and magnetic shielding of the envelope. The cathode is only partly bypassed. The ratio of R3 and R4 was chosen to give an overall amplifier sensitivity of 22 db.

The second driver stage, using paralleled sections of a 6BL7GTA, has the difficult task of driving the highly capacitive inputs of the three 2A3's at up to 100 volts peak-to-peak. Despite the relatively low plate resistor of 12.1K, this stage is still the limiting factor in the overall high frequency response. An unbypassed cathode resistor reduces distortion in this stage, but this raises the output drive impedance, lowering the high frequency response. To compensate for this, the small capacitor C8 was added to even the response and reduce phase shift at high frequencies. C1 serves the same purpose for the first stage. This type of circuit is called "Cathode Compensation" and was developed for video amplifiers. C1 and C8 were chosen experimentally to give the flattest overall frequency and phase response.

The output stage is cathode biased, with about 20 volts extra drop in the cathode resistors to allow a bias adjustment, using R13. Medium and low frequencies are bypassed around

