

Audio Preamplifier Board

Overview

This is a stereo audio preamplifier board featuring an active Baxandall tone control stage for both left and right channels, followed by a dual-channel volume control. The circuit is based on the NE5532 low-noise dual op-amp, operating on a ± 12 V dual-rail supply, providing clean and accurate amplification for line-level audio inputs such as AUX sources.

Key Features

- **Input:** Stereo AUX (3.5 mm audio jack)
- **Tone Control:** Active Baxandall configuration (bass + treble boost/cut)
- **Amplifier IC:** NE5532 dual operational amplifier
- **Supply Voltage:** ± 12 V regulated (from external or previous dual power supply board)
- **Controls:**
 - Dual-ganged potentiometers for Bass, Treble, and Volume, ensuring both channels adjust simultaneously
- **Output:** Dual RCA or pin header for left and right channels

Circuit Description

1. Baxandall Tone Control

- The active Baxandall network provides symmetrical boost and cut for low and high frequencies by varying feedback around the op-amp.
- Instead of merely attenuating frequencies (as in passive designs), the active configuration amplifies desired ranges, maintaining a flat overall gain near 0 dB when controls are centered.

Typical Frequency Response (approx. values based on chosen R and C):

- Bass control ($R = 10\text{ k}\Omega$, $C = 22\text{ nF}$): cutoff $\approx 250\text{ Hz}$
- Treble control ($R = 3.3\text{ k}\Omega$, $C = 1.8\text{ nF}$): cutoff $\approx 3\text{ kHz}$

Boost/Attenuation Levels (estimated):

- Bass: $\pm 15\text{ dB}$ @ 100 Hz
- Treble: $\pm 14\text{ dB}$ @ 10 kHz

(These values are derived from tone-control transfer functions with op-amp gain of ~20 dB and the given R–C network.)

2. NE5532 Operational Amplifier

- Slew Rate: 9 V/ μ s \rightarrow suitable for high-frequency, low-distortion audio
- Input Noise Density: 5 nV/ $\sqrt{\text{Hz}}$ \rightarrow low background noise
- Gain Bandwidth Product: 10 MHz
- Typical THD: 0.0005 % \rightarrow audiophile-grade performance
- Operates reliably from ± 5 V to ± 15 V rails, here biased at ± 12 V for best dynamic range.

3. Volume Control Stage

- Final dual-ganged potentiometer (RV3) acts as a master stereo volume control, placed after the tone stages.
- Each channel's wiper feeds the final output coupling capacitor (4.7 μ F), ensuring DC blocking and preventing bias shifts to subsequent amplifier stages.

PCB Design

- 2-Layer PCB with separated analog ground and power planes to minimize noise coupling.
- Short feedback traces and star-ground topology for low-hum operation.
- Positioned potentiometers at board edge for easy access on a front panel.
- Designed for integration with ± 12 V dual power supply board.

Applications

- Stereo preamplifier for DIY or powered speakers
- Audio equalization for small amplifier systems
- Educational analog electronics project (tone-control design)
- Signal conditioning for class-D or AB power stages