

Specifications & Associated Tests:

Project: Hearing Aid. This project explored operational amplifiers and filters to create a hearing aid with multiple bands that either focused on the amplification of human speech or high frequency signals.

- Without the additional filters, the device is able to amplify all signals by a gain of 47 with a cutoff frequency of 159 Hz.
 - Test: Using the function generator, feed a sine wave of 4 mV into the circuit with a starting frequency of 50 Hz. An increase in the output voltage should be witnessed until the frequency reaches 1600 Hz. Specifically, the gain and output voltage witnessed and recorded in the range of 1600-3200 Hz should decrease.
- Device is able to amplify and filter signals in the frequency range of 72-260 Hz for the bandpass filter with a gain of 61.1
 - Test: Using the function generator, feed a sine wave of 4 mV into the circuit with a starting frequency of 50 Hz. An increase in the output voltage should be witnessed until the frequency reaches 5000 Hz. Specifically, the gain and output voltage witnessed and recorded in the range of 5000-7000 Hz should decrease.
- Device is able to amplify and filter signals with a cutoff frequency of 1591 Hz for the high-pass filter with a gain of 94.
 - Test: Using the function generator, feed a sine wave of 4 mV into the circuit with a starting frequency of 50 Hz. An increase in the output voltage should be witnessed until the frequency reaches 5000 Hz. Specifically, the gain and output voltage witnessed and recorded in the range of 5000-7000 Hz should decrease.
- Device is able to operate (in active mode) on battery power for at least 1 hour and maintain all functionality.
 - Test: Fresh batteries will be given to the device, then the device will be left in active mode for one hour. All specification tests will be performed after this 1 hour.
- The device's input is not limited to solely the function generator. The signal picked up by a microphone can be fed into the circuit and produce the audible, expected output.
 - Test: Replace the function generator's leads with the microphone, paying special attention to the polarity of the microphone. Plug in the speaker to the audio jack that acts as a buffer for the output. An optional component is to plug in headphones to the speaker. If using the speaker, make sure the speaker is the farthest it can possibly be from the circuit and facing the opposite direction of the microphone to reduce feedback. The volume can be adjusted using either the potentiometer or the volume dial on the speakers.
 - Test for Bandpass Filter: Make sure the switch is flipped upwards. Have one person whisper into the microphone. From the speakers, one should be able to hear a slightly distorted voice without noise.
 - Test for High-Pass Filter: Make sure the switch is flipped downwards. Have one person whisper into the microphone. From the speakers, one should be able to

hear a clearer audio output than the bandpass filter and the ambient noise in the background. This filter has a higher gain than the bandpass because we wanted to amplify higher frequencies more than lower frequencies because people tend to lose their high frequency range hearing first.