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| Brigham Young University - Idaho |
| ECEN 250 – Lab 9 (Lab 5 Continued) |
| Treble & Bass – Assemble, Troubleshoot, and Evaluate Performance |
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| **9/29/2023** |

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# Objectives

Design and implement the treble and bass control subcomponents of the stereo amplifier system. This will be integrated with the amplifier stages you implemented in previous labs, and you will assemble the PCB that you designed in lab 5.

# Principles to Be Studied

* Frequency response
* Sinusoidal steady state response analysis of active circuits
* Operational amplifier filter circuit design
* High & low frequency filter Bode plots.
* Wave simulation in PADS Designer
* SMT soldering.

# Background

Most stereo systems have some sort of equalization, with a tone control adjustment for bass, treble, and perhaps a few mid-band adjustments as well. The design for this lab will allow you to boost (amplify) or cut (attenuate) the bass and treble frequencies by selecting specific capacitor values that allows you to control at what frequency to start boosting or cutting.

# Design Specifications

Bass

* For : minimum Boost & maximum Cut
* For : maximum Boost & minimum Cut
* For and at mid Bass setting: max. Boost & min. Cut

Treble

* For : minimum Boost & maximum Cut
* For : maximum Boost & minimum Cut
* For and at mid Treble setting: max. Boost & min. Cut

# Procedures

Diagram

Description automatically generatedFigure 1 – Stereo System (Right and Left Channel) Block Diagram

In Lab 5, you designed a PCB for a generic high and low pass filter for 2 channels and determined the component values needed to meet the design specifications for your stereo amplifier.

In this lab you will assemble the PCB and take measurements to evaluate its performance.

# Bass

Refer to the Bass subsection in Lab 5 for expected results and component values.

# Treble

Refer to the Treble subsection in Lab 5 for expected results and component values.

Be sure to include your work from Lab 5 in your report.

# Performance Evaluation

Once the circuit is simulated correctly, solder your chosen components to your PCB. Complete *Table 3* and ensure that your circuit meets design specifications Refer to Appendix A instructions on how to take these measurements to complete the table below. Use the benchtop power supply so that PSRR does not distort your readings.

Table – Frequency Response Measurements

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Channel** |  | **Treble** | | | **Bass** | | |
|  |  |  |  |  |  |
|  | **Left** |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Right** |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  | **Left** |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Right** |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  | | | | | | | | |

# Pass Off

After yourbass and treble board is working, integrate the bass and treble control into the rest of your system for the final sign off.

# Lab Report

Your grade on this lab is based on the pass-off and the lab report itself. Lab report requirements can be found on I-Learn. The grading rubric is below. Include a schematic of your entire system in your report. This can be in multiple sheets or a single sheet.

|  |  |
| --- | --- |
| **Points** | **Description** |
| 50 | SMT pass-off |
| 5 | PCB Design Steps Summarized   * Table of Design Rules * Schematic * Screenshot from JLCPCB |
| 10 | Gain Equations: From Lab 5   * Table 4 w/ answer to question * Table 6 w/ answer to question |
| 10 | Simulations   * Bass * Treble |
| 15 | Design specifications met.   * Appropriate Oscilloscope screenshots (5) * Table 1 Frequency Response Measurements (10) |
| 5 | Conclusion |
| 5 | Lab report quality (see I-Learn - Lab 1 Module) |
| **100** | **Total** |

# Appendix A – Male Header Jumper Configuration

There are 49 male header pins that allow modular functionality for the kit. Starting from the top left, you’ll notice three pins labeled “Power input.” These are used to provide DC power to the kit, or as test points for the power rails (when plugged into the wall). Never supply power from both the AC inlet and a DC source. The rest of the headers serve to enable the different stages of the circuit. All the picture represents the circuit under normal operation (all stages enabled).

On the lower left, the ‘Buffer IN’ header connects the audio left and right input with the buffer left and right inputs. If debugging the circuit, you may take the input from the jack directly from here, or use the pins to connect an alternate input into the buffer (i.e. a function generator). The ‘PreA IN’ has the same function for the microphone input.

Next are two symmetrical 8-pin headers above and beneath the Line buffer. These correspond to the left and right channels respectively. “Vol I O” represents the input and output pins for the volume potentiometer. “Buf O” represents the output of the line buffer. Similarly, “Mix I O” represents the input and output of the audio mixer. Both pins by “Bal In” are balance pot inputs. The last one corresponds to the bass input. You may bypass the volume pot, for example, by taking the buffer output and shorting it to the mixer input. Likewise, you may bypass the bass & treble by placing the shunt over the mixer out and balance in. If only the volume and balance control is desired, then the volume output may be shorted directly to the balance input. Lastly, you may use female to female DuPont cables to set other configurations (i.e. buffer to bass).

Graphical user interface

Description automatically generatedOn the lower side of the board in the middle are jumpers that connect the Preamplifier output to the microphone volume input and a one that connects the microphone volume output to the mixer input.

On the right side of the board we find the “Pwr EN” header. This connects the positive and negative supply rails to the power-amp. Therefore, the power-amp is disabled if the shunts aren’t present. You’ll want to keep it disabled whenever you bypass the power-amp stage so that it doesn’t distort the output signal.

For the last two headers, “B O,” “T O,” “P O,” and “Bal Out,” correspond to the Bass, Treble, Power-Amp, Balance outputs respectively. Similarly, an “I” represents the input pin for those stages. The “Out” pin represents the output jack’s connection. Whenever you want to bypass the power-amp, you’d connect directly to this pin, as shown in the figures.

# Appendix B – Frequency Response Measurements

Diagram

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Diagram, schematic

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Diagram, schematic

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A picture containing text, electronics

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A picture containing text, electronics

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Graphical user interface, application, timeline

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