Custom SHARC Development Board with Analog Audio I/O

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1 Introduction

This semester, we decided to build a new SHARC development board that can handle audio input and output. This expands upon the capability of the existing SHARC development board in the ECE 395 lab by allowing analog input.

2 PCB Design

We used Mitch’s SHARC development board as a base for our own design. While there were many things he got right in his design, we added a few features that would add necessary functionality.

2.1 Schematic

At first, our plan was to just add a new section to Mitch’s board, to allow for analog audio input. As we began to implement this design, we made changes as needed and the design ended up being quite different. In addition to the functionality of his board, we added an analog input section and merged the daughterboard we made to sample potentiometers into the overall schematic. The analog input section has the ability to switch between balanced and unbalanced input (generally to choose between a guitar and a microphone). The guitar signal goes through a simple op-amp circuit, while the microphone signal path passes through an instrumentation amplifier.

2.2 PCB Layout

Due to cost constraints of PCBWay, we were limited to a 100 × 100 mm² board, which meant completely redesigning the layout we inherited from Mitch. This involved ripping up all traces, moving parts around, and integrating the new sections of the board. In addition to the main SHARC board, we designed a small user interface (UI) board containing 6 potentiometers and a push button for tap tempo. It connects to the main board via a ribbon cable and a header.

2.3 Issues Encountered

- We forgot to connect the DC barrel jack to the 12V LDO in our power section.
- The drill holes are plated - this isn’t necessarily a problem, but they shouldn’t be.
- The spacing between the JTAG header and the UI header is a bit too tight.
- The header on the UI board needs its columns swapped.
3 Assembly & Ordering

We decided to order our boards from PCBWay, and due to the complexity of the surface mounted parts and time constraints, we also had them assemble the boards. The process went very smoothly once a few ambiguous sections of the board were enumerated.

We found a script online to sequentially order the part numbers from upper left to lower right, making it easier to follow the board design for whomever would lay out the actual board. We found another script to generate a Centroid file.

4 Debugging

4.1 Analog Issues

We learned that without grounding the second input to the op amp, the op amp was not working properly, so the ADC was receiving a dead signal. After grounding the second input, everything worked correctly.

4.2 Digital Issues

We were experiencing issues with JTAG. While running the program on the SHARC via VisualDSP++, the program would abruptly halt. We would receive an error message such as "GetReg failed". After power cycling the board, we would be able to run the program again but only for 15 - 30 seconds. We were also unable to program flash on this board. We tried running our program on a different board, and it worked correctly. We never did determine why this board was not working. It may be a cold solder or something else entirely.

5 Plans for the Future

- Make the true bypass button into a software-controlled digital bypass, using a physical momentary switch. This will allow us to have greater control over bypass, as well as do unique things with an LED to indicate different "pedal states"

- Combine main board with UI board, and re-orient it to be “portrait” instead of “landscape”. This will be less cluttered when fitting the board into an enclosure.