Lab #7: Digital to Analog Conversion

Physics 127BL Winter 2024

Lab report due **Wednesday, February 28, at 11:55 P.M.**

Please read the lab report and homework guidelines handout on the course web page.

Introduction

In this lab, we will use an 8-bit digital to analog converter (DAC) to drive a speaker from the FPGA board at a volume of our choosing. This converter will be used in the next few labs as part of a tone generator and music player.

The DAC will produce a square wave, the amplitude of which will be set by 8 slide switches. The output will appear on one pin of the VGA port, and will be connected to a speaker via an audio adapter.

There are no lab files provided, as you will be creating the block diagram from scratch.

Wiring the DAC

1. Download a fresh copy of the `lab6_part3` directory and rename it `lab7`. Then use the `TopLevel` block diagram to design the circuit for this lab.

2. To set the frequency, generate a logic signal from an appropriate output bit of a counter module (not the carry out) so that it oscillates at about 1 kHz. This line is then connected to the select input of an 8-bit multiplexer (made with the megafunction `LPM_MUX`), which selects for the output either the number 00000000_2 or a number set by the slide switches. The 8-bit output of the multiplexer is then connected to the bus called `VGA_R[7..0]`. This is the input for the DAC that produces the analog VGA "red" signal. See page 51 of the FPGA board manual on the course web page. For the VGA output to function, you also need to connect your clock to an output called `VGA_CLK`.

3. Check for proper operation of your generator. When it is running, the amplitude of the sound should be proportional to the number set by the slide switches. It might be useful to test the 1 kHz generator part of the project by connecting this line directly to the audio output. Just remember that `VGA_R[7..0]` needs all 8 bits defined to function properly.

Keep in mind that the oscilloscope and Quartus simulator can also be handy for debugging and demonstrating that your code works, since you can't put sound in a lab report.