# University of North Texas, College of Engineering
# Department of Electrical Engineering

## EENG 3910: Project V - Digital Signal Processing System Design

### Assignment 5

Lab Session:Monday, 03/07/2016
Due: Monday, 03/21/2016

**Student Name: _____**

**Important:**

- Please create a new assignment folder in your working directory for each assignment, and a new problem folder in the assignment folder for each problem.
- Please backup your files in your own USB drive or your own network drive at the end of each class because the workbench computers may be reimaged without prior notice.

**Problem 1. Audio signal pass through with ADC and DAC.**

**Part I. Simulation and implementation of input and output interface circuits**

- Follow the Getting Started document "Getting_Started_CCS6.pdf" to create a new CCS project for Tiva C Series LaunchPad. You may name the new CCS project as Lab4_1.
- Delete the "main.c" file if you have generated that file automatically when you were creating your new CCS project.
- Copy your own source code file "Lab4_2_main.c" into your project folder. That is, we will use the program that you wrote for Assignment 4 Problem 2 (signal pass through with ADC and DAC).
- Change the Timer1 interrupt rate to 44.1kHz by setting SAMP_FREQ=44100.
- Build, load, and run your project on Tiva LaunchPad.
- Verify that the program is running by changing LED colors through UART terminal.
- Turn off the power of your LaunchPad.

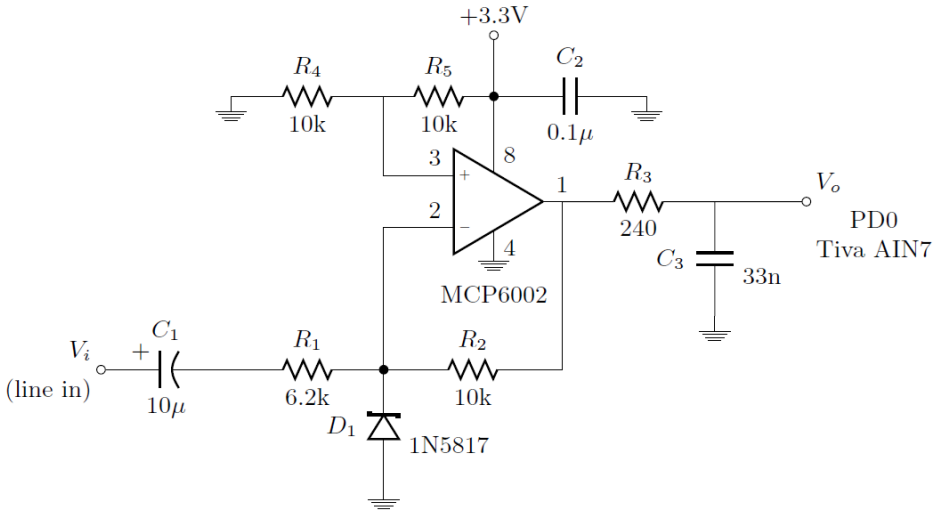


Figure 1: Audio input interface circuit.

- Simulate the circuit in Fig. 1 in PSpice. You can use Cadence, www.circuitlab.com, or TI TINA software. If you cannot find MCP6002 in the parts database, you may use MCP602 or any other single-supply rail-to-rail opamp. If you cannot find 1N5817, you may use any Zener diode such as 1N4728A, 1N4729A, and 1N4736A. Obtain frequency-domain response of the system from simulations.

- Build the circuit in Fig. 1 on the left-half space of a breadboard. Connect a function generator at the input $V_i$ and connect oscilloscope at the output $V_o$. Only connect power and ground pins to LaunchPad. Do not connect to PD0 pin yet.
- Configure function generator to output a sine signal with Vpp = 2V, no DC offset, and frequency equals to 200, 1000, 2000, 10k, 15k, 20k Hz, one at a time. Observe the output signal on oscilloscope screen. The output signal should be a sine signal with the same frequency as input signal but with 1.5V DC offset and around 3V Vpp. The Vpp value may vary for signals with different frequencies.

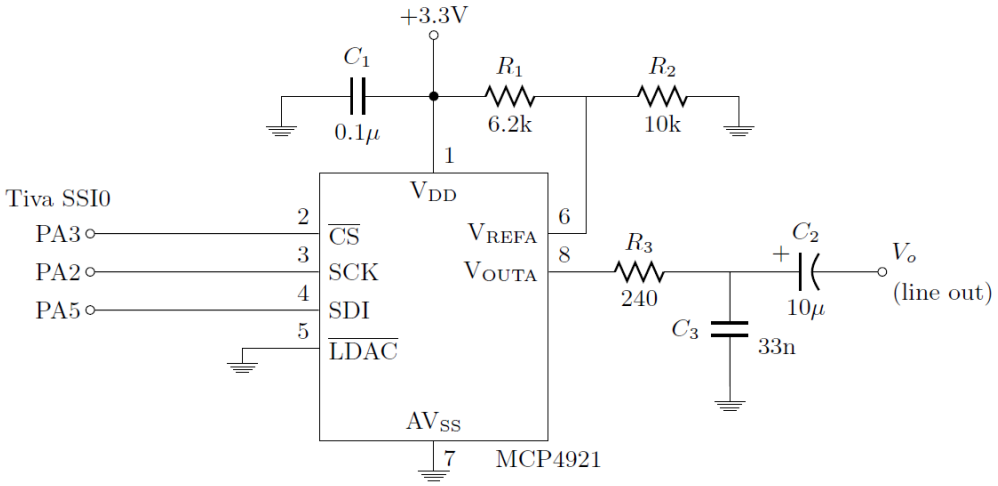


Figure 2: Audio output interface circuit.

- Build the circuit in Fig. 2 on the right half of the same breadboard.
- Connect both circuits to your Tiva LaunchPad. Again, connect the ground and 3.3V power pins to LaunchPad. Do not use a separate power supply.
- Turn on the power of your LaunchPad to run the Lab4_2 program on the board (with SAMP_FREQ=44100.).
- Connect function generator to the input of Fig. 1 circuit. Connect oscilloscope channel 1 to the input of Fig. 1 circuit, and connect oscilloscope channel 2 to the output of Fig. 2 circuit to display two signals on the oscilloscope screen simultaneously.
- Configure function generator to output a sine signal with Vpp = 2V, no DC offset, and frequency equals to 200, 1000, 2000, 10k, 15k, 20k Hz, one at a time. Observe the signals on oscilloscope screen. The two signals should have the same frequency, no DC offset, and similar Vpp.
- In your report, explain the circuits in Fig. 1 and Fig. 2 and your observations.

**Part II. Experimentation with audio signals**

- Turn off the power of LaunchPad.

- Connect computer audio line out signal to the input of your system (i.e., input of Fig. 1 circuit) and connect line out signal of your system (i.e., output of Fig. 2 circuit) to a powered speaker or headphone. For both connections you will need to use the 3.5mm audio jack shown below, which can be directly plugged into breadboard. Also, connect oscilloscope to the line out signal of your system. For the stereo audio plug connector shown below, left channel is on the tip, right channel is on the ring, and the ground is on the sleeve.

- Turn on the power of LaunchPad.
- Run the program "gen_sin_sound.m" in Matlab as signal generator. Observe the output from both speaker and oscilloscope. You may need to increase the signal duration in the Matlab code to get a stable capture on oscilloscope.
- Vary the frequency of signal in Matlab code to 200, 1000, 2000, 10k, 15k, 20k Hz, one at a time, and observe the output.
- Instead of generating sound signal from Matlab, play a music file on your computer (or play an audio/video clips from online repositories such as www.youtube.com) to pass the audio signal through LauchPad then to the speaker.
- Now you are ready to do some real-time digital signal processing in your LaunchPad. We will learn to do just that in the next a few assignments.

**Assignment Deliverables:**

- Compile your report with pictures, plots, and the codes that you have written or modified.
- Explain in detail what you have done, why you have done in that way, and what you have learnt. Follow the report format outlined in the Introduction lecture notes.
- Email your report and source codes for grading. For source code submission, you will need to zip your working directory and send the zipped file to your TA at VeenaChidurala@my.unt.edu.
- Printout of your source code should be attached to your lab report as appendix. If your source code goes beyond two pages, please only print the part of the source code where you have newly written or modified.