Department of Engineering

EE 3710 Lab 8

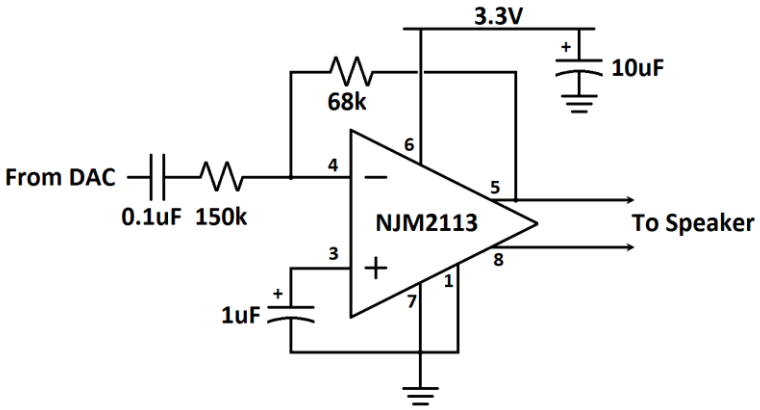
Title: Software Doorbell.

Objective: The student should understand the nature of a DAC and its time-critical behavior. The student should be able to write a program that updates the DAC at a fixed time interval.

Parts: Project from Lab 7
1 NJM2113
1 8Ω speaker.
Resistors and capacitors as required by your design.

Preparation: Write the title and a short description of this lab in your lab book. Make sure the page is numbered and make an entry in the table of contents for this lab.

Design a circuit that interfaces one of the C8051F020 DACs to the NJM audio amplifier. A good starting point is the circuit shown below.



Build your circuit and connect it to a 3.3V power source. Use a function generator to input a 2.4V peak-to-peak sinusoid of about 1kHz and verify the outputs of the NJM2113 (pins 5 and 8) show a sinusoid of at least 1V peak-to-peak. If not, check your circuit or consult the NJM data sheet for more information.

Once the output is correct, wire the input of your circuit to the DAC output. (Leave the speaker disconnected for now). Record your schematic in your lab book.

Download the code for Lab 8 (bell.c) from the course website. This program emulates a doorbell by outputting an 800Hz sine wave for one second followed by a 635Hz signal for one second. Study the code then modify it as follows:

1. Make the amplitude of the sine wave decay with time (this will make it sound a little more like a bell).
2. Set bit 5 of CKCON to disable the ÷12 divider for Timer 2 (making Timer 2 run at system clock speed). This allows you to set the frequency more accurately. Make sure to update RCAP2H and RCAP2L accordingly.
3. Rewrite the main loop so that both buttons ring the doorbell, each with a different tune. Each tune must have at least two notes. (Have some fun with this.)

Note that the frequency of note n is given by the equation:

$$f_n = 440(2^{n/12})$$

Where n is the number of chromatic steps above the key of high A. For example, middle C would be 9 steps below high A, so its frequency would be $440(2^{-9/12}) = 261.63$Hz. Note, however, that the speaker provided in class attenuates frequencies below 600Hz significantly.

Create a project file for this lab, add your program to your project and build it. Make sure there are no assembly errors.

Lab Work: Connect to your project as usual, build the original bell.c from the course website, download it and run it. (The bell is activated by the pushbutton on the 8051 board.) Using an oscilloscope, first probe the output of the DAC then the outputs of the amplifier to verify that everything is working properly. When you are certain that the amplifier is not overdriving the speaker, attach the speaker and verify the doorbell works as intended.

Download the code you wrote as part of the preparation for this laboratory exercise. Run your program and verify that it works.

Disconnect your project and cycle the power. Verify that your program operates as it did before.

Write a summary/conclusion in your lab book and demonstrate your stand-alone doorbell to the lab instructor.