PROCEDURE

Part a) Decide which port pins you will use for the inputs and outputs. If you plan to do the game in Lab 15, we suggest you place the DAC on Port B so that you can share your game with other students. To use the simulator/grader the choices are listed in Tables 13.1 and 13.2. In particular, Table 13.1 shows you three possibilities for where you can connect the DAC output. Table 13.2 shows you three possibilities for where you can connect the four positive logic switches that constitute the piano keys. Obviously, you will not connect both inputs and outputs to the same pin.

DAC bit 5	PA7	PB5	PE5
DAC bit 4	PA6	PB4	PE4
DAC bit 3	PA5	PB3	PE3
DAC bit 2	PA4	PB2	PE2
DAC bit 1	PA3	PB1	PE1
DAC bit 0	PA2	PB0	PE0

Table 13.1. Possible ports to interface the DAC outputs (DAC bits 4 and 5 are optional).

Piano key 3: G (783.991 Hz)	PA5	PB3	PE3
Piano key 2: E (659.255 Hz)	PA4	PB2	PE2
Piano key 1: D (587.330 Hz)	PA3	PB1	PE1
Piano key 0: C (523.251 Hz)	PA2	PB0	PE0

Table 13.2. Possible ports to interface the piano key inputs.

Figure 13.2 shows four screen shots of Lab 13 in simulation mode. Figure 13.2a shows the option tab for configuring Keil for Lab 13 simulation. Figure 13.2b shows the dialog window for interacting with the Lab 13 input/output. In this window you specify which pins you plan to use for input and which pins for output. Set the number of DAC pins by setting the resistance values. A blank field means that pin is not connected to the DAC. Figure 13.2c shows you how to configure the logic analyzer to display voltage versus time. The symbol **DACOUT** will be generated by the simulator from the microcontroller digital outputs and the resistance network you specify. The last figure shows the **DACOUT** as a sine wave is being generated. You could add the digital outputs to the logic analyzer and see both inputs and outputs of the DAC.

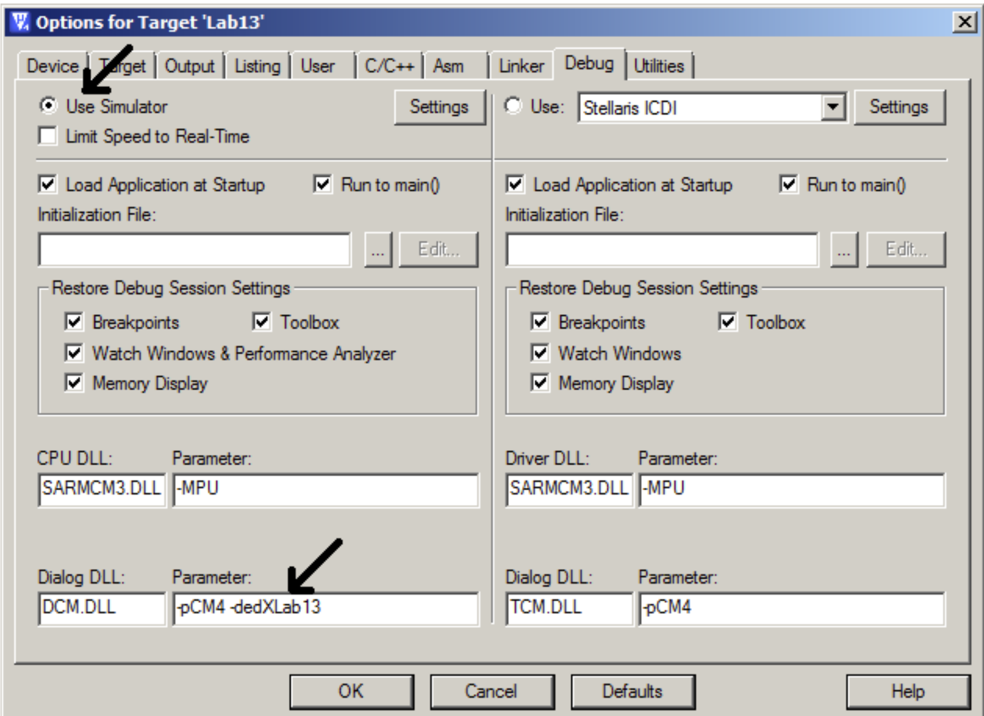

Figure 13.2a. Configure Lab 13 to run in simulation.

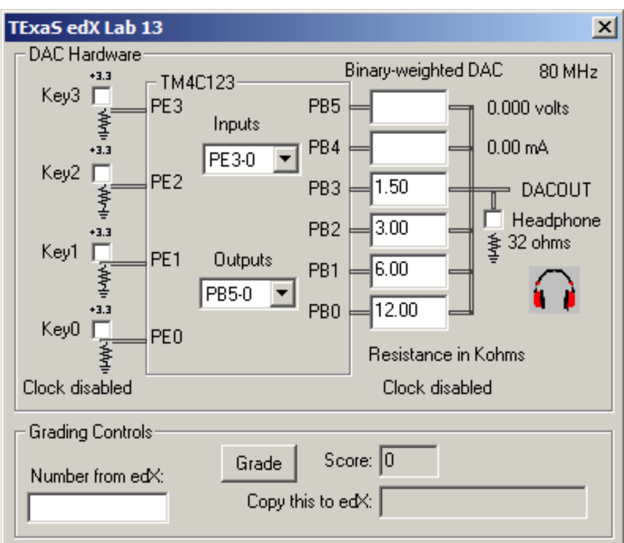

Figure 13.2b. Lab 13 I/O interface in simulation.

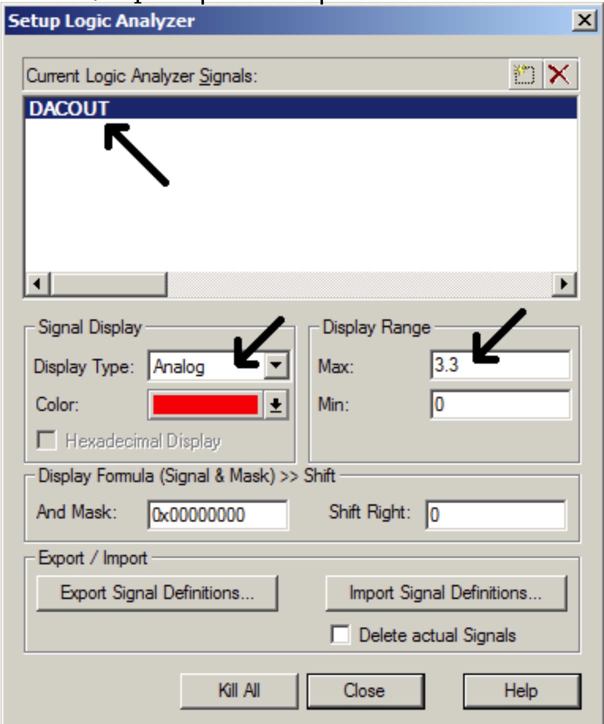

Figure 13.2c. Setup logic analyzer to plot **DACOUT**.

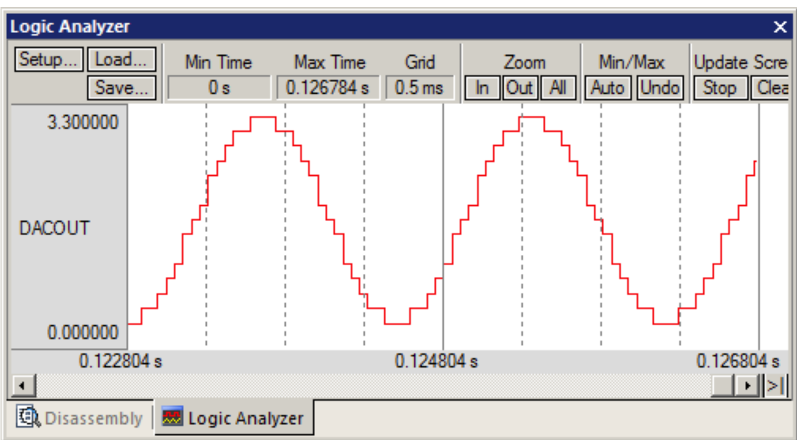

Figure 13.2d. Logic analyzer output running Lab 13 in simulation.

Draw the circuit required to interface the binary-weighted DAC and four switches to the TM4C123. Design the DAC using a simple resistor-adding technique. A 4-bit binary-weighted DAC uses resistors in a 1/2/4/8 resistance ratio. Select values in the 1 kΩ to 240 kΩ range. For example, you could use 1.5 kΩ, 3 kΩ, 6 kΩ, and 12 kΩ. Notice that you could create double/half resistance values by placing identical resistors in series/parallel. Lab 12 presented three ways to connect the headphones to your circuit. The best solution is to insert the audio jack directly into the breadboard. You could solder 24 gauge solid wires to the audio jack. You could strip some 24 gauge solid wire and wrap it tightly around the headphone plug.

If your lab kit doesn't have three 1.5 kΩ and three 12 kΩ resistors, here are three options:

a) Try another set of resistors with 1/2/4/8 resistance ratio, such as 1 kΩ, 2 kΩ, 3.9 kΩ, 8.2 kΩ.

b) Get three each of resistors with 1/8 ratio, such as three 2 kΩ and three 16 kΩ.

c) Get any 12 resistors of the same value (1.5 kΩ to 22 kΩ) and build a 4-bit R-2R ladder like figure 13.13 in section 13.4.

During simulation you use the binary-weighted DAC, but for the real board you use the 4-bit R-2R DAC.

Help