BCD Counter with seven-segment display
EE 3109 Computer Aided Digital Design
Lab Assignment #5

Lab Report Due: October 19, 2009
The purpose of this exercise is to design a BCD Counter with seven segment display. You should use 2 BCD counters and 2 seven segment displays. **One counter must trigger next counter.** The first counter should go through sequence of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1 … etc. When the first counter changes its value from 9 to 0, it should send a trigger signal to the second counter to increment it by 1.

I. Create a symbol for the circuit designed in Lab 3. (BCD counter)
II. Add two of these symbols to the Lab 5 worksheet.
III. Create a symbol for the BCD to Seven-Segment decoder circuit in Lab 2.
IV. Add two of these symbols to the Lab 5 worksheet
V. Use the outputs from your BCD counters as the inputs for your 7-segment display. The circuit should have a total of 3 inputs (Count, Clock, and Reset) and 4 outputs Sec1 (4 bit), Sec2 (4 bit), Disp1 (7 bit), and Disp2 (7 bit)

VI. Inputs
1) The **enable input** will behave as follows: This is same as the Enable input from previous lab.
   - Enable = 1 enables the clock i.e., it should go to the next binary state
   - Enable = 0 disables the clock i.e., it should stop counting
2) A **clock timing signal** to increment the clock by one.
3) A **reset signal** to reset the clock to 0000.
   - Reset = 0, the counter works normally
   - Reset = 1, resets the clock

VII. Outputs
1) **Sec1** – Output from the first BCD counter. Since the output from BCD counter is 4-bit, modify the output pin which is into a 4-bit output. (Instructions in the next page)
2) **Sec2** – Output from the second BCD counter.
3) **Disp1** – Seven-segment display to the output from the first BCD counter.
4) **Disp2** – Seven-segment display to the output from the second BCD counter.

VIII. Use the following specifications
1) Clock – 1ns period with 50% duty cycle
2) Grid size – Time Period of 1ns with 50% duty cycle
3) End time – 25ns
IX. Your report should contain the following

1) Schematics:
   a) The final design.
   b) The schematic of your BCD Counter.
   c) The schematic of your 7-segment BCD display.

2) Waveforms:
   a) The inputs and outputs of your final design showing that the circuit outputs 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, etc. (Enable = 1, Reset = 0)
   b) The circuit working as described above, with the Reset = 1 in the middle. (Enable = 1)
   c) The circuit working with the Enable = 0 in the middle. (Reset = 0)

X. Turn in the report before 5:00PM on the due date. Remember to write your report in the format that was given to you in the first class.

How to create an output bus:

1. Double click on the output pin and the pin properties window as shown below opens.

   ![Pin Properties Window]

2. Since the display has 7 bits, enter [6..0] after the pin name. Note that there are two dots between 6 and 0.

3. Name the output pin as indicated in the lab instructions. (Ex: Disp1[6..0])

4. Use the normal node wire and create a line that is not connected to any other device from the output being used.

5. Right click each node wire and go to properties to name each node. The purpose of naming the node wire is for the Bus to recognize each pin. (Ex: Disp1[6] through Disp1[0])

6. Use the orthogonal Bus tool, which is located on the tool bar display just below the normal node wire and resembles a thick line, to connect all the node wires to the output pin. Important: all the wires coming from the output of the symbol should be connected to the Bus line.

7. Name this Bus line the same way the node wire was named, except the name will be exactly the same as the output pin. (Ex: Disp1[6..0])