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|  | Experiment 3Introduction to Field Programmable Gate Arrays and Logic | Michael Ward Section 308 9/19/2019 |

# 9/5/2019

**Objective**

Train on the programs we will be using for the course of the semester and create a circuit design / code that can be used on the FGPA board, then simulate and test said circuit design.

**Equipment**

Software: Altera ModelSim 12, Altera Quartus II

## Procedure

1. Open the Quartus project from Experiment 2
2. Edit the circuit design to include outputs for the inputs so we can see if they are on or off
3. Create the Switch Map shown in Figure 2
4. Use the Pin Planner to map pins using the Switch map in Figure 2
5. Connect the inputs to the logic gates and the logic gates to the outputs (as shown in figure 1)
6. Recompile
7. Turn on the Cyclone II
8. Flash the program to the Cyclone II using the Programmer.
9. Attach the Cyclone II to the oscilloscope using all the pins in the proper places.
10. Turn off the unneeded channels.
11. Label all the channels.
12. Flip the correct switch on or off to demonstrate that the circuits are working properly, and document as such as shown in Figures 3 and 4.

**Questions** (if applicable)

1. **What is the period of IN2? How about the period of IN1?**Period of IN2 is approx. 1.5 nanoseconds  
   Period of IN1 is infinite – it’s on a switch, not a clock.
2. **Outputs AND2, NAND2, OR2 and NOR2 are logic functions of IN1 and IN2. Write down the logic functions implemented for the outputs in terms of IN1 and IN2.**  
   AND2 = IN1 AND IN2  
   NAND2 = NOT(IN1 AND IN2) = NOT(IN1) OR NOT(IN2)  
   OR2 = IN1 OR IN1  
   NOR2 = NOT(IN1 OR IN2) = NOT(IN1) AND NOT(IN2)

## Results & Conclusion

The lab was successful. I fully ran my program on the Cyclone board and verified that it worked properly using the oscilloscope.

## Printouts, Tables, Figures

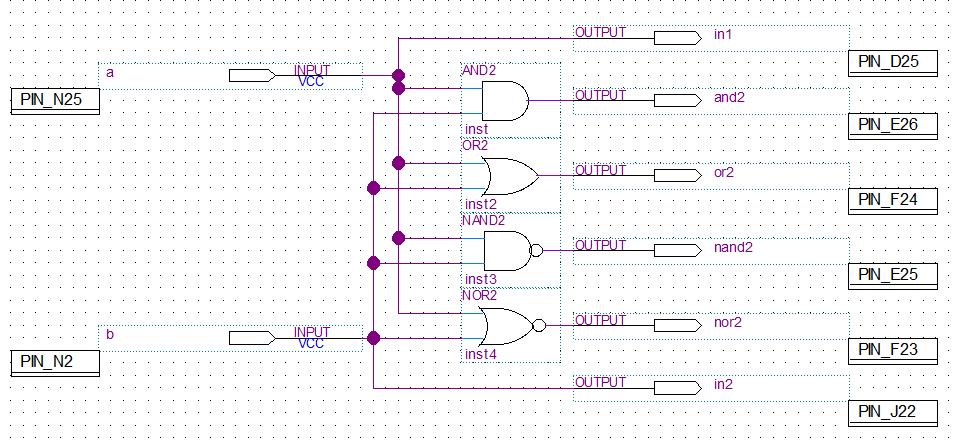


Figure 1: Logic Circuit Diagram

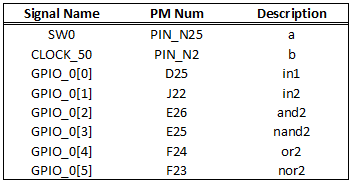


Figure 2: Switch Map

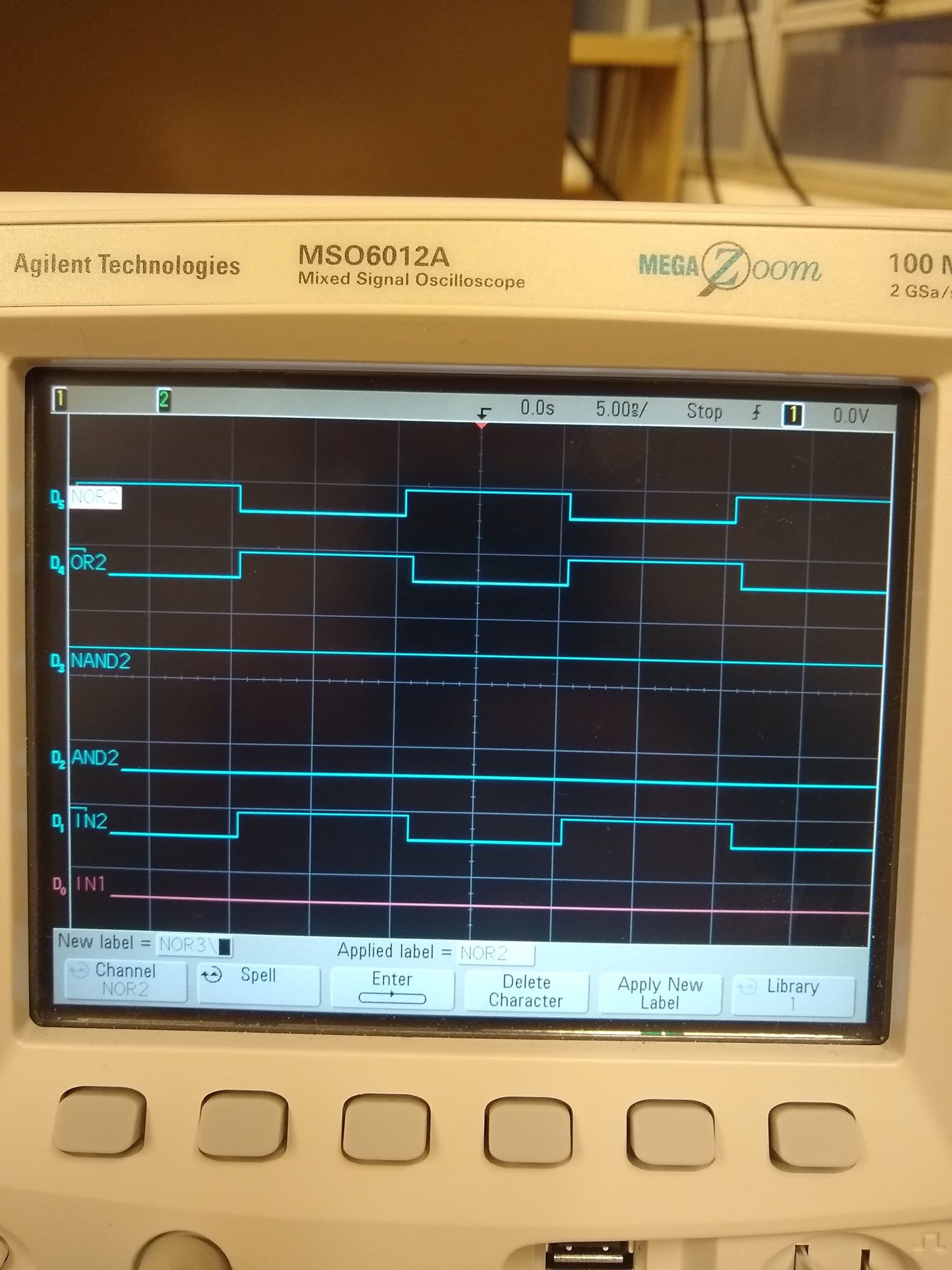


Figure 3: Input 1 off

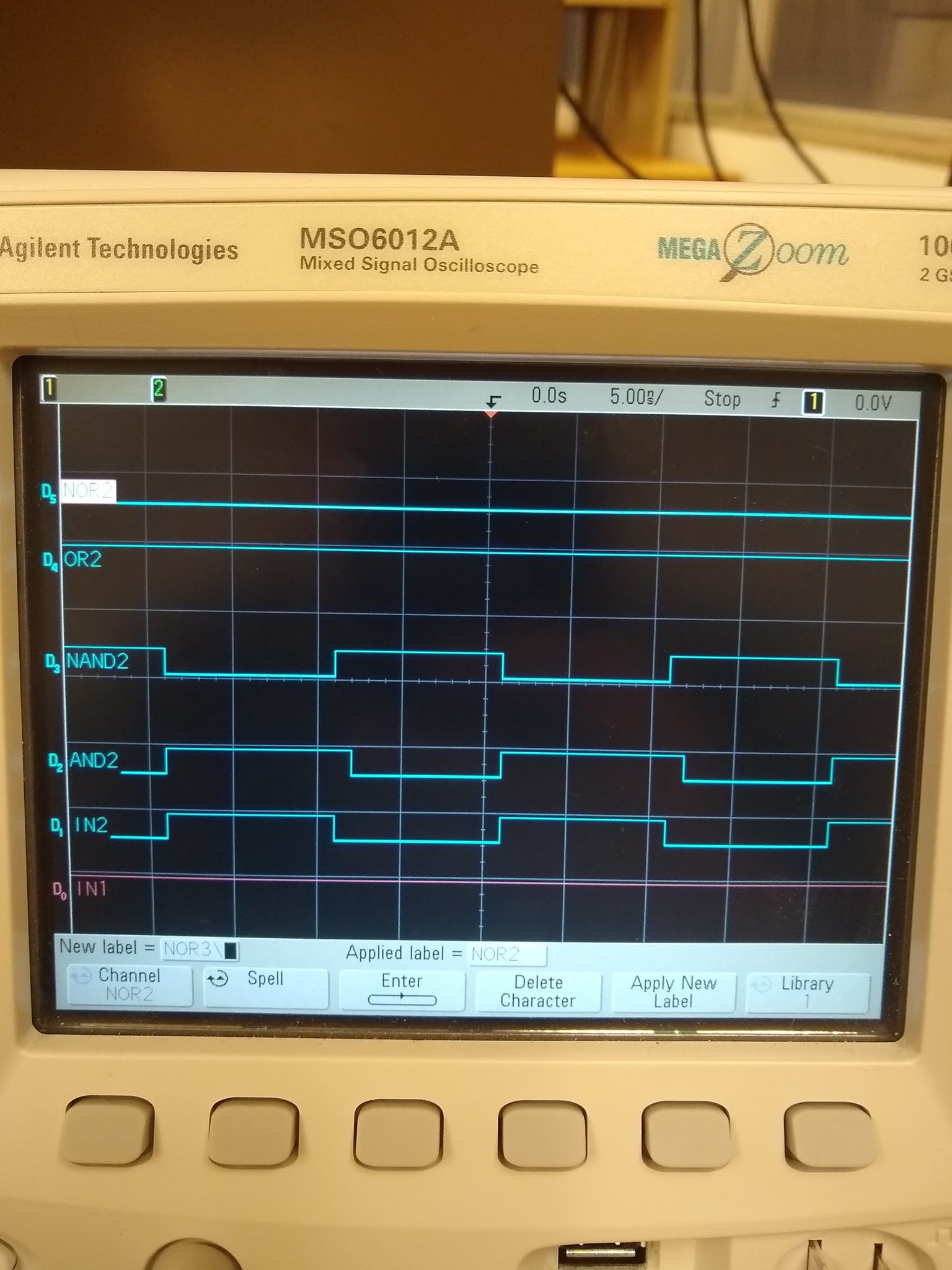


Figure 4: Input 1 on