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Engineering – 303

Lab 0

5/10/2017

Introduction/Description

In this lab, I was expected to be able to figure out how a protoboard works and how to implement circuits on this board. This lab allowed me to physically play around with several different types of circuits. In this lab, I was instructed to create several different types of circuits. The first circuit I had to create was testing an OR gate module. The circuits after that were also designed to test other modules and see how they work. The last circuit that I created in the lab was called a combinational circuit. This circuit involved more than one gate. Also, these gates were of a different type.

Design

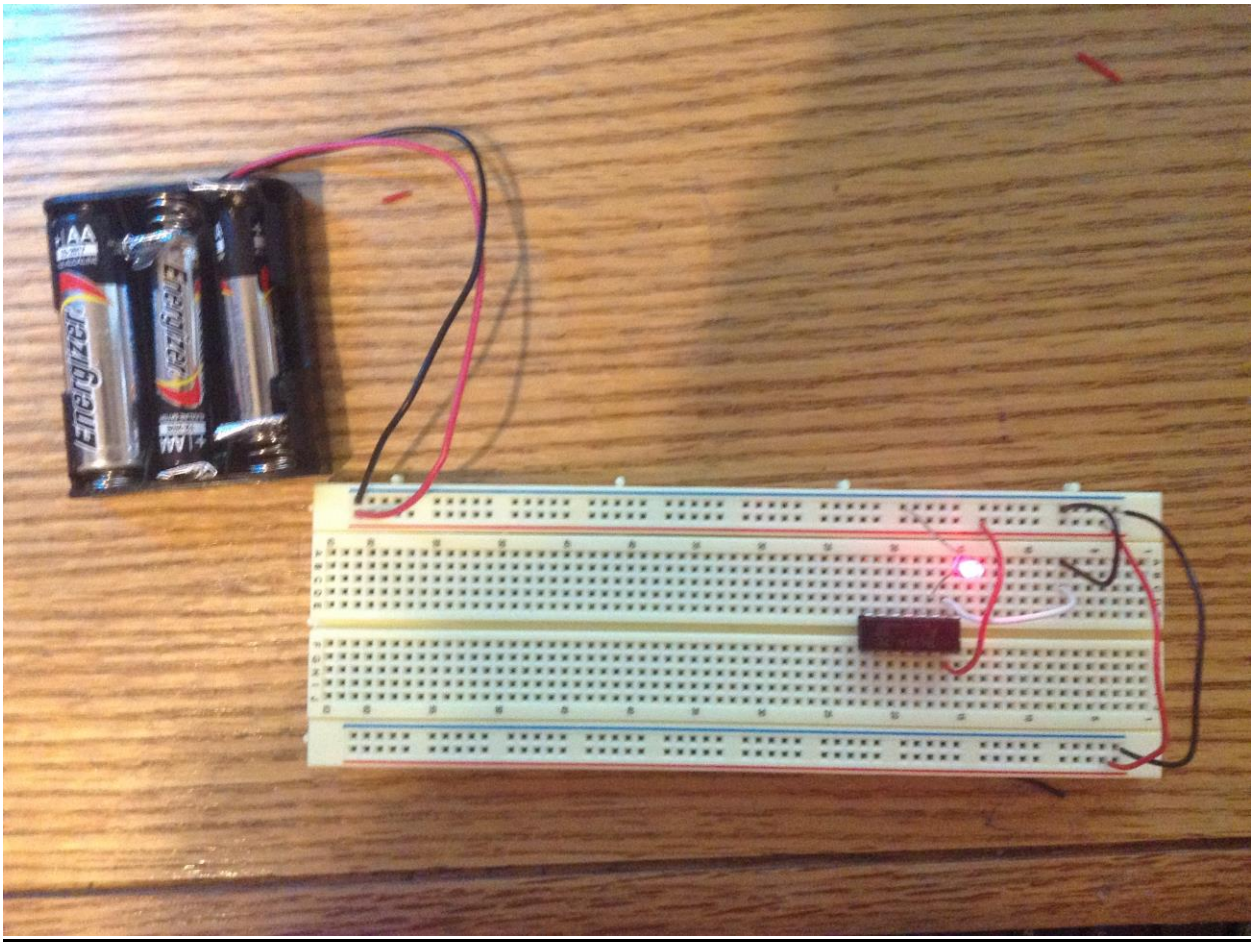
Part 0 – Protoboard Familiarization

My first task in this lab was to familiarize myself with how a protoboard works and how it is wired. After googling a couple YouTube videos to figure out where I needed to connect the power leads I was able to quickly tell what was happening. On the protoboard, there are two columns each on the farthest left and right of the board. These two are used for connecting the power and the ground. All of the pins in each section of the columns are interconnected. For example, all of the power pins are connected to each other on the right side of the board. The same goes for the ground pins. In the middle of the board, there are two columns of pins separated from each other by a gap in the middle of the board. Each row of these columns are connected together. The reason for the gap in the middle of the board is to enable the user to connect modules to the board without accidentally interconnecting pins on each side of the module.

Part 1 – Testing Individual Modules

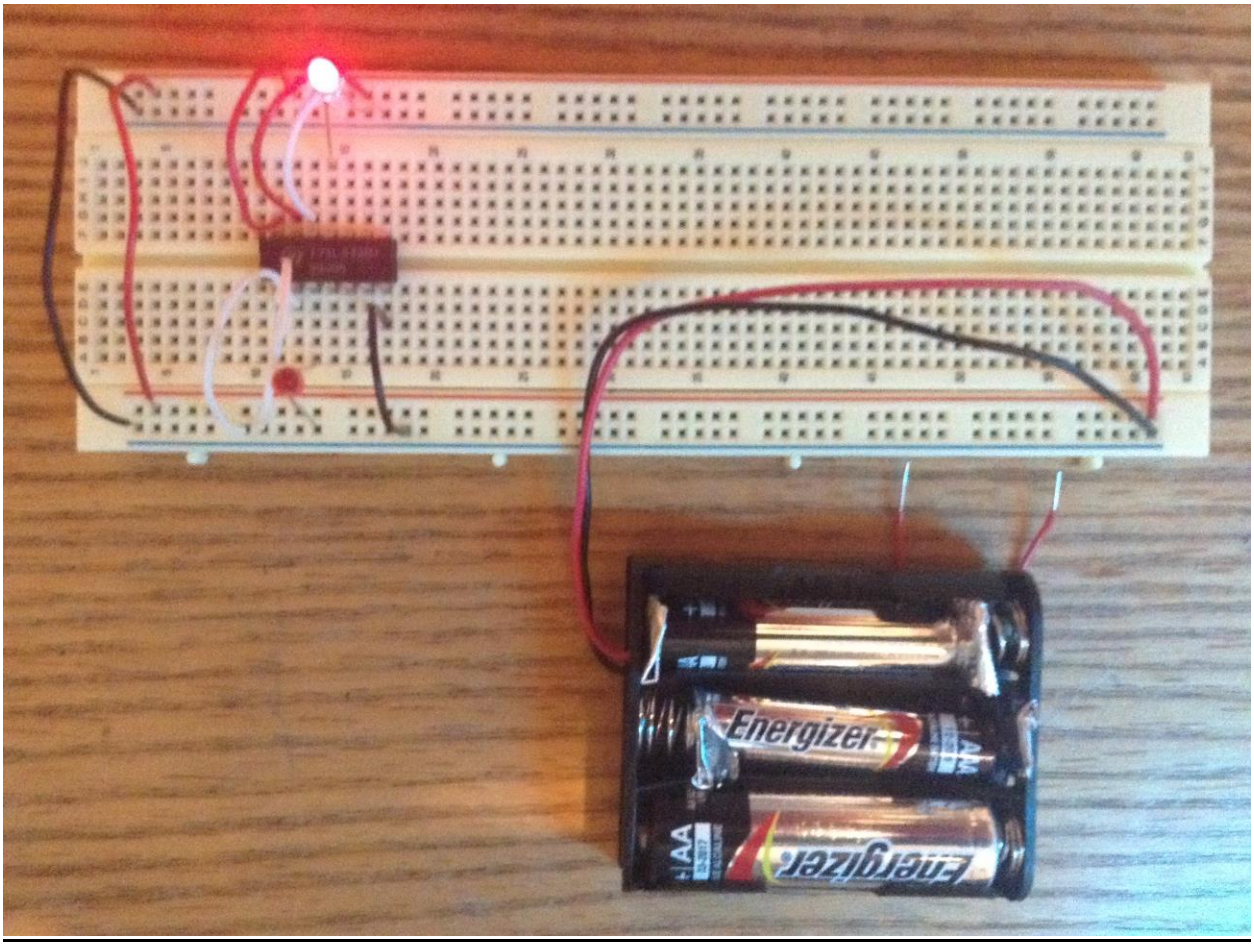
My next task in this lab was to individually test some of the modules on the board. The first module that I tested was a module that contained six individual NOT gates. To test this circuit I connected a ground wire to one of the inputs of the gate. Then I connected the output to a led. This caused the led to light up. I also tried connecting power to the gate. This caused the led to turn off.

Here is a picture of me testing the NOT gate.



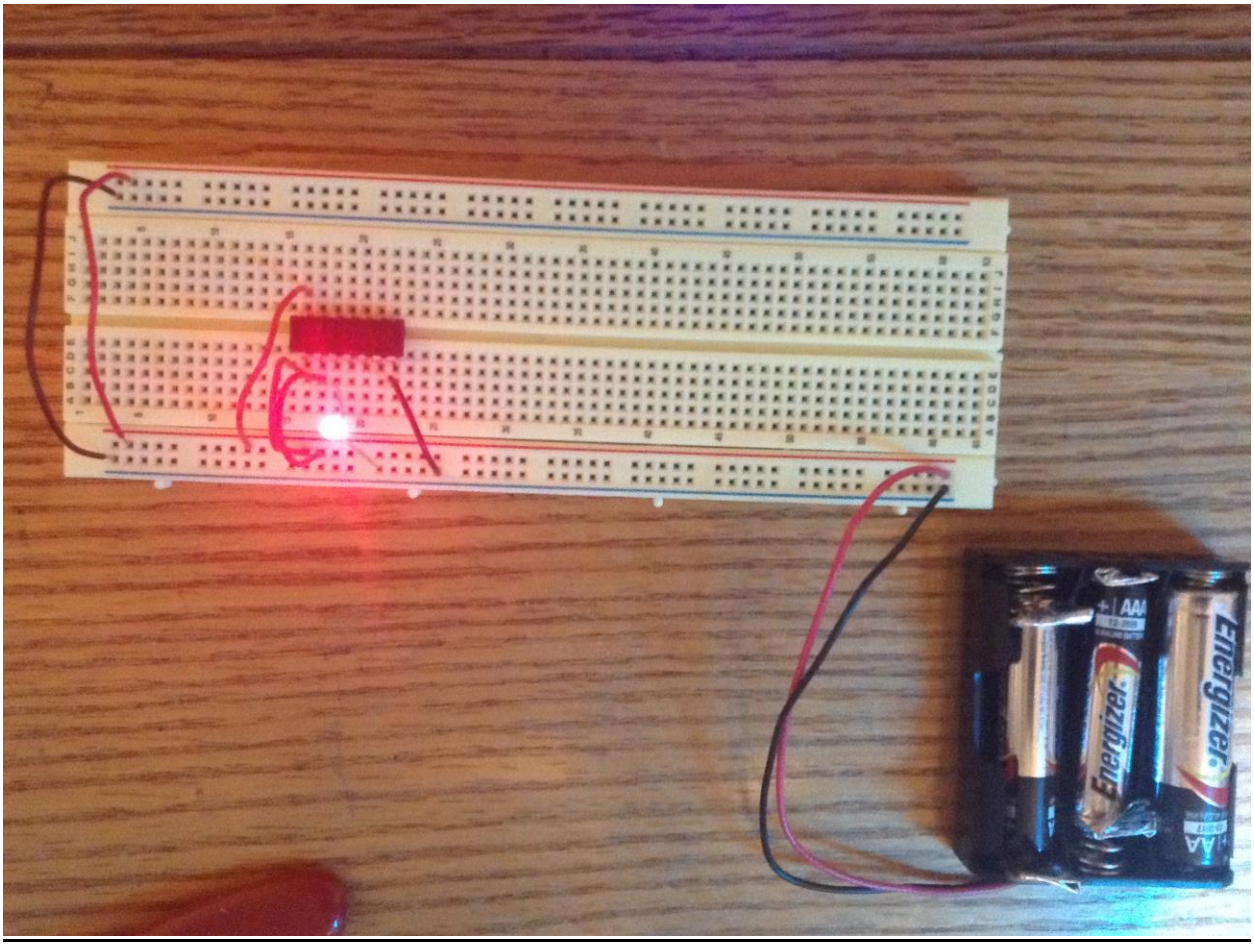
The second module that I tested was a module that contained 4 individual OR gates. To test this I connected one of the inputs to ground and the other to power. This sent an equivalent of binary 0 and 1 through the gate. This caused the gate to output a 1 or power in this instance. I was able to see this by connecting a led to the output of the gate.

Here is a picture of me testing the OR gate.



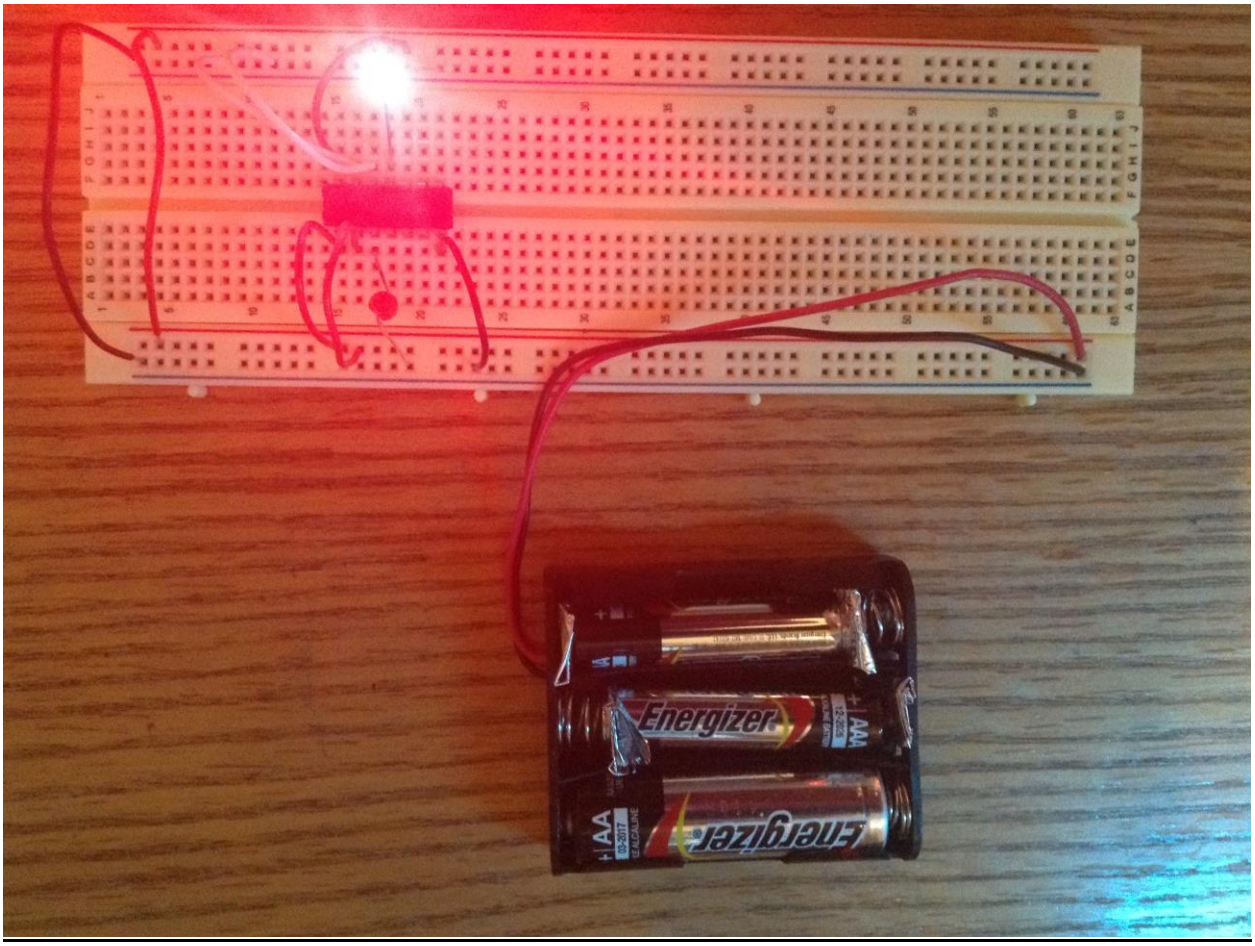
The third module that I tested was the AND gate module. This module contains a total of 4 individual AND gates. I tested this module in the same manner as the other ones.

Here is a picture of me testing the AND gate.



The fourth and last module that I tested was full of NAND's. This module acted the same way as the AND module with the only difference being that the output was reversed before actually being outputted.

Here is a picture of me testing the NAND gate.



Part 2 – A small Combinational Logic Function.

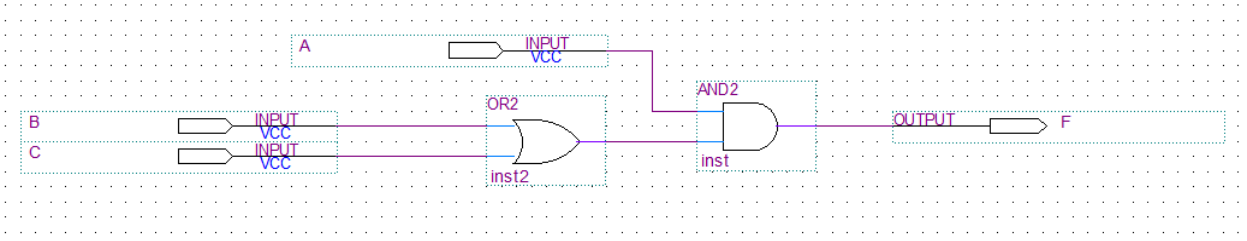
In the final section of the lab, I was supposed to design a circuit on the board that would correctly implement the circuit equation F = A (B + C). This circuit means that inputs B and C need to be put through an OR gate. The output of this OR gate will then be sent through an AND gate along with input A.

Here is the Truth Table for the circuit.

Inputs			Output
A	B	C	F
0	0	0	**0**
0	0	1	**0**
0	1	0	**0**
0	1	1	**0**
1	0	0	**0**
1	0	1	**1**
1	1	0	**1**
1	1	1	**1**

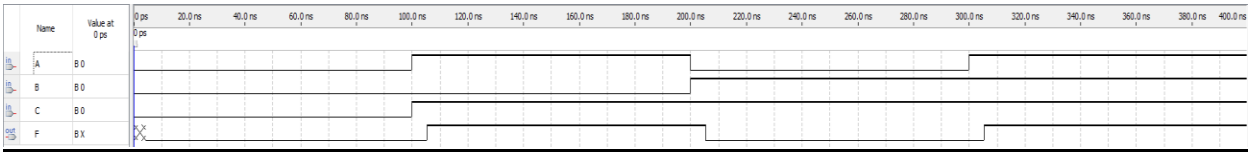
Note, for the circuit diagram of this circuit I built and tested the circuit in Quartus.

Here is the Block-Diagram for the circuit.



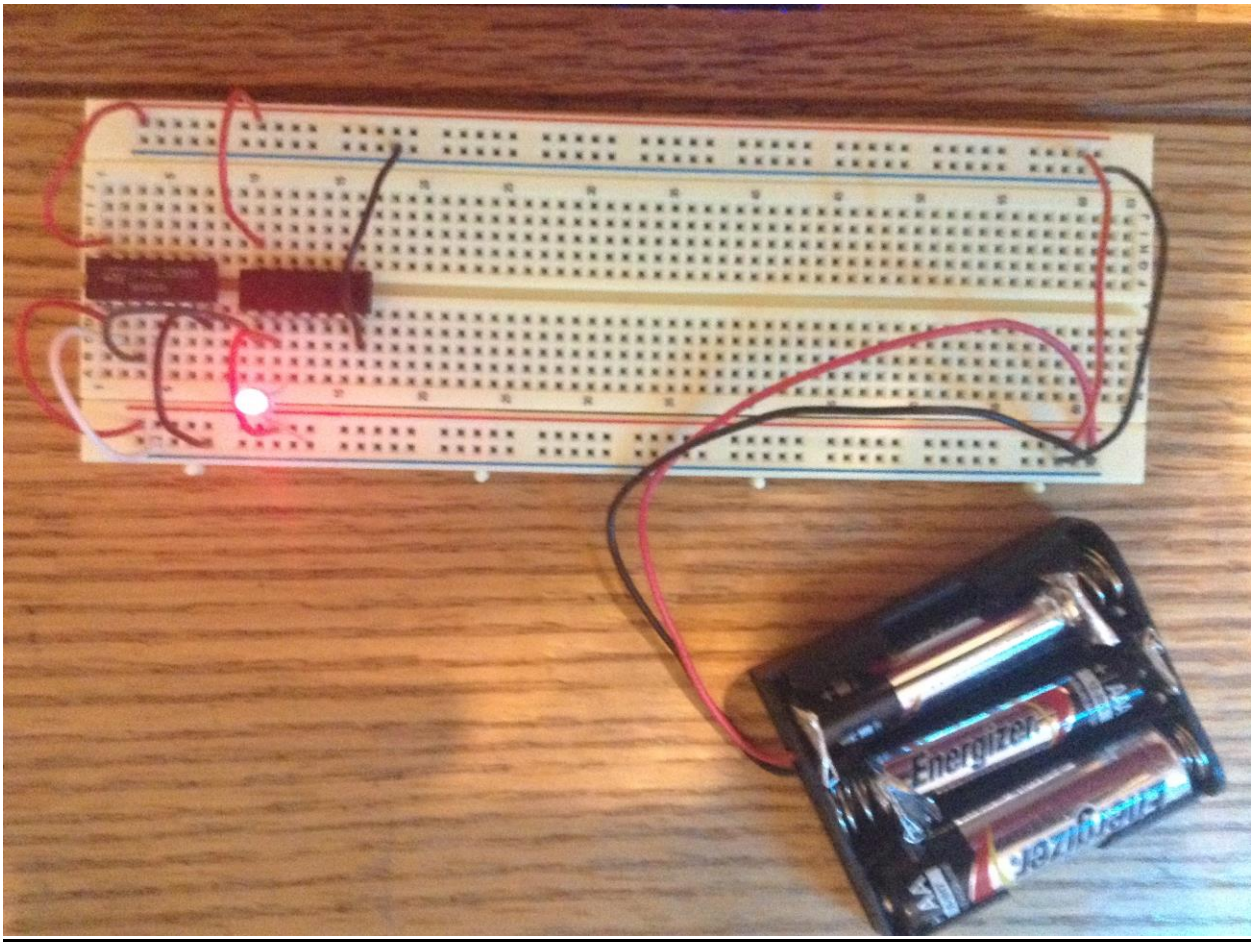
When testing the above circuit I encountered no problems and it performed as expected for every single input combination.

Here is the waveform for the circuit.



After completing all of this preliminary work I put the circuit on the protoboard.

Here is a picture of me testing the Combinational Circuit.



Conclusion

This lab was quite fun to implement. I have actually never used a protoboard before and accomplishing this lab made me learn the basics of one. It was really neat to be able to test a circuit that I built with my own hands by physically connecting individual wires. Overall, I enjoyed this lab and am sorry it is over. Please note, if you are trying to figure out why I have tinfoil in the battery box it is because I was unable to find any batteries of the AA size in my house. This forced me to use tinfoil to connect AAA batteries to the box.