Lab 1: Digital Logic Gates

ECEN 248 - 505

TA: Younggyun Cho

Date: September 8, 2020

Objectives

The objective of this lab was to familiarize ourselves with different breadboarding techniques and wiring. This helped me to understand the functions of the different parts, along with understanding and interpreting logic gate behaviors, and learning circuit wiring and troubleshooting. These are the key components that will carry the basics of digital circuits. While introducing the lab equipment to myself, I also learned how to operate integrated circuits on the breadboard, and develop skills on the basic logic gates like NOT, AND, OR, NAND, NOR, and, XOR.

Design

NOT, AND, OR, NAND, NOR, XOR

Result

The experiments were a lot easier to get through when I understood how the wiring worked, and what positions gave the most accurate and stable readings on the multimeter, which just came with a lot of trial and error. The NOT gate only had one input so the wiring configurations were different from an AND or OR gate, as they required two inputs. For the datasheets, the position of the ICs was important, because the incorrect placement of them could alter the results. Each IC was measured for whether the output was high or low. High meaning (“1” or “on”) and Low meaning (“0” or “off”). The ranges for high lies anywhere between 3.9 and 4.2 V and for low around 93 mV. Not all my results lied in this range but were fairly close to

it. The higher reading could be because of damages in the ICs or inaccuracy in the reading of the multimeter.

Table 2: Truth Table for Inverter (NOT Gate)

A (High/ Low)	Y (Volts)	Y (High/Low)
Low	4.47 V	High
High	94.6 mV	Low

This table shows the outputs for the NOT gate, measured by the multimeter. A NOT gate inverts inputs, hence Low input should be (NOT low), hence resulting in a High voltage as shown above.

Table 3: Truth Table for AND & OR Gates

A (H/L)	B (H/L)	AND2 (V)	AND2 (H/L)	OR2 (V)	OR2 (H/L)
L	L	105.2 mV	Low	83.1 mV	Low
L	H	112.4 mV	Low	4.83 V	High
H	L	112.4 mV	Low	4.87 V	High
H	H	4.71 V	High	4.97 V	High

This table shows the outputs for the AND and OR gates, measured by the multimeter. A AND gate takes the inputs, such as, Low AND High, which results in a Low voltage. Whereas for an OR gate, the inputs Low OR High, results in a High voltage as shown above.

Table 4: Truth Table for NAND, NOR, & XOR Gates

A (H/L)	B (H/L)	NAND2 (V)	NAND2 (H/L)	NOR2 (V)	NOR2 (H/L)	XOR2 (V)	XOR2 (H/L)
L	L	4.96 V	High	5.07 V	High	163 mV	Low
L	H	4.97 V	High	87.2 mV	Low	4.94 V	High
H	L	5.01 V	High	87.2 mV	Low	4.92 V	High
H	H	157.8 mV	Low	0.00 V	Low	19 mV	Low

This table shows the outputs for NAND, NOR, and XOR gates, measured by the multimeter. Consider the inputs for a NAND gate, where it takes a high NAND low (NOT(high AND low), which results in High because NAND just inverts the result of an AND gate.

Conclusion

In this lab, I learned everything that was targeted in the objectives of this experiment. I walked myself through the basics of digital circuits and learned about the fundamentals component of it, which is logic gates. I not only learned the functions of the lab equipment and became more skilled in the use of breadboard, but also learned how to design and test a circuit. I was able to test the output voltage of the circuits and double checked if it corresponds to the truth tables inputs represented by the different logic gates. This overall taught me more about the design of NOT, AND, OR, NAND, NOR, and XOR designs and how the wiring works to get a practical output.

Post - Lab Questions

1. What did you like most about the lab assignment and why? What did you like least about it and why?

The one thing that I liked most about this lab was that I got to implement the theory we learned about logic gates in class, and see how it works in a real circuit. This really helped me understand the concepts and get a better perspective on the different types of logic gates. The one thing that I liked the least is that we couldn't have a lab partner or that it was independent because I believe it would have been helpful to talk through the procedure while performing the lab.

2. Were there any sections of the lab manual that were unclear? If so, what was unclear? Do you have any suggestions for improving clarity?

The lab manual and video provided was a little confusing while figuring out how to perform the lab. Especially since many students are working from home this semester, and having in-person access to a TA isn't there, it would've been helpful to have a more in-depth video explaining what we are doing and why.

3. What suggestions do you have to improve the overall lab assignment?

For the lab manual itself, it would be a lot more helpful to have a list of steps than paragraphs, so we know what order we are going in, and updated videos.