ELEC 2210 LABORATORY REPORT COVER PAGE

Complete and attach this page to the front of your lab report.

Meeting # 4 Binary Arithmetic Circuits

Title of Lab Experiment

Student Name: Emerson Gabriel T

Name (Last, First, MI)

Student Email: gte0002

AU 7-character username

GTA: Paul Atilola

Name of your GTA

Section you are enrolled in: (Circle One): 1 2 3 4 5 6 7 8

Date experiment performed (dd / mm / yy): 2/2/21

Date report submitted: (dd / mm / yy): 2/8/21

If you performed this experiment at a time other than your regularly scheduled section meeting:

Section # of the section you sat in on (Circle One): 1 2 3 4 5 6 7 8 Makeup

Name of the GTA who supervised your work: ______________________

I hereby certify that the contents of this report are true and complete to the best of my ability. The lab work was performed by me exclusively, and this report was written by me exclusively.

GT Emerson

Student signature

2/8/21

Date signed

Gabriel Emerson
ELEC2210 T 11am
Experiment 4: Binary Arithmetic Circuits
02/09/21

In this lab, I learned how to build a digital logic circuit that added not only two-bit binary numbers, but also four-bit binary numbers including their carry out value. Through the building of these circuits using the adders on my breadboard, I had to figure out how to connect the LED's and TTL output so that the output, or sum and carry values were accurately represented by the LED's and on the ELVIS workstation. Throughout the lab, I had to use my knowledge of adding binary and the equivalent sum and carry in theory to implement and verify adders in a physical circuit; in other words, I was able to apply what I knew about adding binary numbers to a real-world situation.

Step1:

In the first section of the lab we build and tested the 4-bit adder. The 4-bit full adder was used to add two 4-bits binary numbers. One of the numbers called A would come from a 74161 counter and the other one called B would come from the Digital Writer.

In order to perform the binary addition, we first connected the 74161 counter and verified correct operation. The counter clock was applied by the Digital Writer via bit DI07. The ELVIS LED'S (LED0-03) were used to show the outputs of the counter which are the values of our binary input A. The counter worked correctly counting from 0000-0001…-1111 and rolling over to 000. We next proceed to connect the adder 4-bit full adder. Input A was connected to the adder via inputs A1-4. The input B was applied by the Digital Writer via bits DIO3-0 and then connected to the adder via inputs B1-4. The carry input (called C0) was also applied by the Digital Writer via DI0-4 and connected to pin 13 of the adder which is the C0 input. The sum bits labeled 1-4 were connected to the breadboard LED's LED04-7.
The Carry Out of the adder was connected to a separate LED / resistor (220Ω) series combination to display the Carry Out. Before connecting the resistor, we first measured its resistance with the DMM and recorded the value. The value obtained for its resistance was 221.6Ω. After connecting the red LED light to the resistor and carry output, I tested the circuit to ensure the adder was functioning correctly, verifying I connected everything correctly. Table 1 illustrates the correct outputs I found.

Table 1. Test results for the 4-bit full adder circuit. All values in hex

Inputs			Calculated Outputs		Actual Outputs		
A	**B**	**CIN**	**COUT**	**S**	**COUT**	**S**	**Check here if correct.**
0	0	0	0	0	0	0	Y
0	0	1	0	1	0	1	Y
1	0	0	0	1	0	1	Y
7	7	1	0	F	0	F	Y
8	7	0	0	F	0	F	Y
8	8	0	1	0	1	0	Y
F	F	0	1	E	1	E	Y
F	F	1	1	F	1	F	Y

Step 2:

Using the built-in DMM on the ELVIS board we measured the voltage across the resistor when our LED was on. Then using Ohm's law we calculated the LED current and compared this answer to the desired value of approximately 24mA.

$V_r = 2.787V$

$I = V/R = 2.787\ V / 221.6\ \Omega = 12.576\ mA$

The value of the current is almost half the desired value.

After doing this, we again used the ELVIS DMM to measure the output high and output low voltages across pins 1 (connected to ELVIS LED) and C4 (connected to LED/resistor combination). We recorded these output voltages first with the LED connected and then disconnected. The values measured are in Table 2.

Table 2. Output Voltage Measurements.

7483 Output Pin	Voltage with LED connected	Voltage with LED disconnected
Σ1 (logic 1 state)	4.48 V	4.61 V
Σ1 (logic 0 state)	0.94 V	0.100 V
C4 (logic 1 state)	4.31 V	4.57 V
C4 (logic 0 state)	0.099 V	0.058 V

The results obtained were within the range of the manufacturer's specifications in the data sheet.

In conclusion, this lab taught me how to design and implement a circuit that added four-bit binary numbers. I gained more experience with the 74161 counter chip and learned to work with the 7483 chips, which was the four-bit counter. I learned that I needed an LED light and resistor in order to protect the chip and LED. I gained more experience working with the ELVIS workstation and learned through my wiring mistakes in both the Prelab and physical circuit exactly how to correctly complete binary addition.

ELEC 2210 Lab Checklist

Student Name Gabriel Emerson

Meeting Date & Time T 11:00 GTA Name Paul Atilola

Section # 001 Station #__________

Meeting # & Title Binary Arithmetic Circuits

Student Instructions: Fill in the items to be checked off by the GTA. When you are ready for checking off, notify the GTA. Include this sheet in your lab report.

GTA Instructions: Initial the student activities as requested in the experiment. Include comments as appropriate.

Part 1 Build & Test 4-bit adder GTA Initials P.O.A.

Comments (GTA / Student):

Part 2 Measure LED and CMOS GTA Initials P.O.A.

Comments (GTA / Student):

Part 3 Cleanup. GTA Initials P.O.A.

Comments (GTA / Student):

Part 4 ____________________ GTA Initials______

Comments (GTA / Student):

Cleanup Inspection GTA Initials P.O.A.