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ECE 218 – Section: L04

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Lab 6: Design of Full Adder and Multi-bit Sequential Adders Using Shift-Registers

Date of the Experiment: 10/13/2023

Due Date of the Experiment: 10/27/2023

I. Introduction

a) Purpose:

The aim of this experiment is to understand shift registers and their role in serial and parallel data processing, especially in the context of adders.

b) Scope:

Some of the limitations for this experiment would be that the experiment uses a model for adders and in the real world the complexity of those circuits can be much greater. In this lab it mentions four implementations of SISO, SIPO, PIPO, and PISO using mode control inputs. The limitation to this is it might not cover the wide range of digital circuit configurations in more complex labs. The last limitation would be that the experiment covers multi-bit sequential adders, but it may not provide a wider range of circuits using multi-bit and multi-word operations.

II. Theory

a) What is the theoretical basis of this experiment?

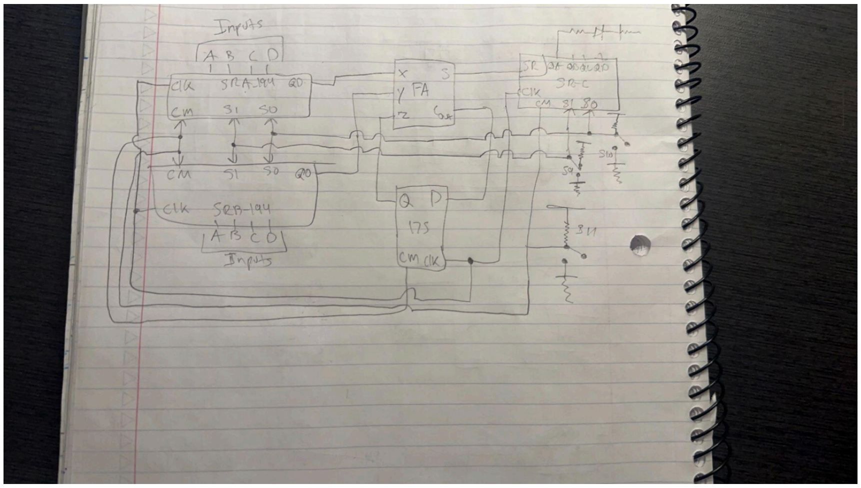
The theoretical basis of this experiment is using digital concepts like, shift registers, full adders, sequential circuits, clock synchronization, and serial and parallel data processing. This lab also uses the concept of control inputs which allows the shift registers to have more functionality.

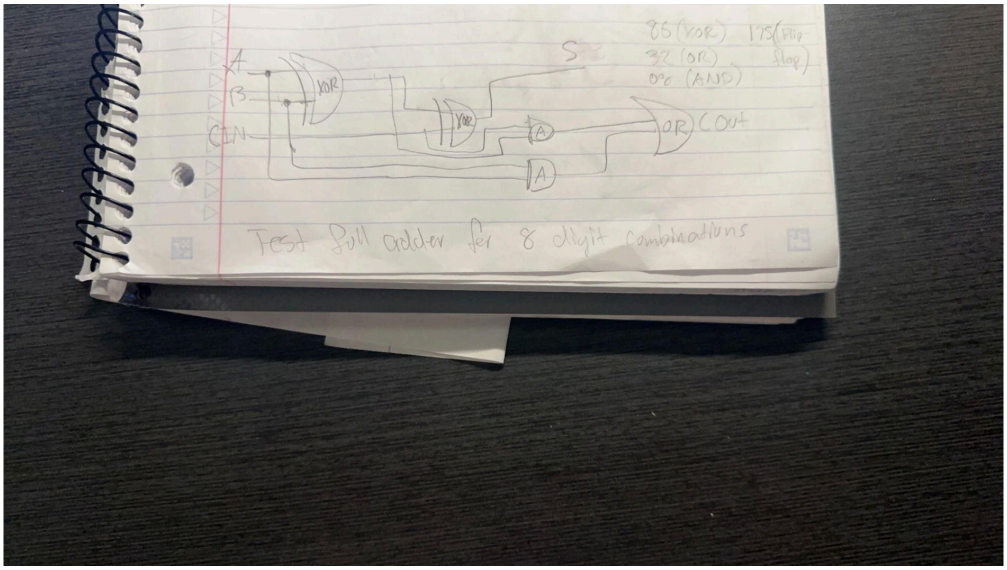
b) What preliminary work was required before the lab session itself?

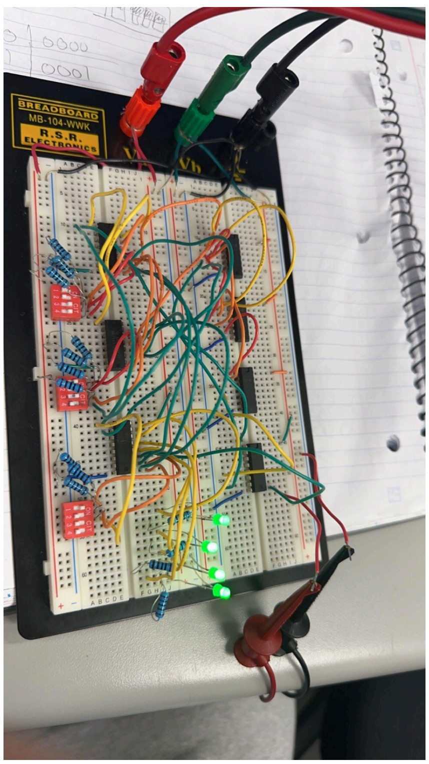
Some of the preliminary work that was needed before the lab session was to answer 4 pre-lab questions prior to starting the lab. These questions have a range of topics related to digital logic gates and circuit design on a breadboard. The first question asks to use the gates from the ICs: 74x194 (x2), 74x08, 74x32, 74x86, and 74x175, and then design the schematic of a 4-bit adder. The second question asks to draw the breadboard layout of the circuit. The last question asks to list the set of actions to operate your serial adder properly and then to draw a schematic of your circuit.

III. Experimental procedure

a) Schematic: Neatly drawn schematic, block diagram, etc., of the circuits used in the experiment, Include the test equipment.




85 (XOR) 175 (flip flop)
32 (OR)
08 (AND)
S
A
B
CIN
XOR
XOR
A
A
OR
COut
Test full adder for 8 digit combinations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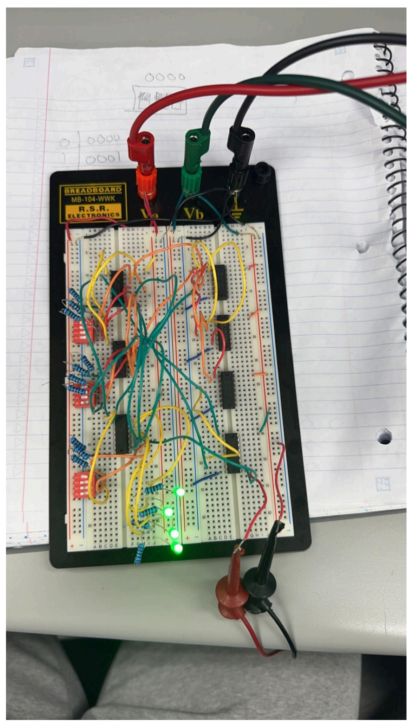
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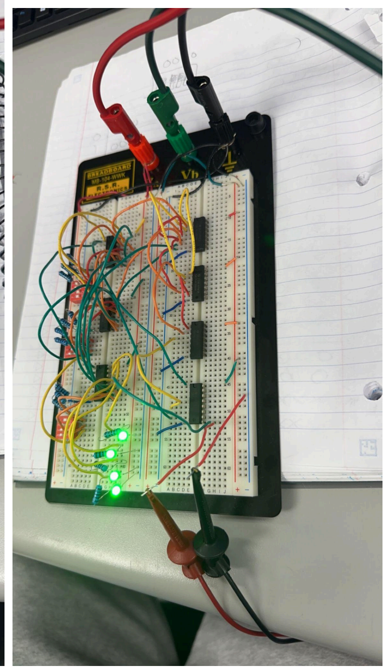


b) Procedure: Outline the methods used in the experiment. **Write this so that someone could replicate your experiment/results by reading your procedure!**

1.) **Put it all of your chips in order of Shift Register, Shift Register, Shift Register, then go to the next side of the breadboard and put Xor gate, And gate, Or gate**

2.) **Connect your three switches all the way on the left side of the breadboard and grab three resistors and connect them in the first three slots of the first switch**

3.) **Next connect four resistors for the first four slots right next to the second switch**

4.) **Now connect three resistors for the first three slots for your last switch**

5.) **First step is to connect the Full Adder**

6.) pin number one of these or gate to pin, number one of the xor gate and we can see that pin number 2 of the and gate is connected to pin number 2 of the and gate so we will connect from pin number 2 to pin number two of the and get then pin number three of does or gate is connected to pin number four of the seconds or get that means pin number three of this I see is connected to pin number four we have to connect pin number three here and it is connected to pin number four so three and four is now connected now pin number four of this or gate is again connected to pin number four of the N again so here is the pin number four one two three four to connected to pin number four that means here pin number four of the engine again pin number five of the circuit is connected to pin number five of the and yet so this one is five because one two three four five this one is five and it is connected to pin number five here spin number five of des and get pin number 3 of the N get is connected to pin number two of the or gate so 1 2 3 here 3 is connected to pin number 2 of the or gate and pin number 6 is connected to pin number one of the or gate so here is the 6 and this 6 is connected to pin number one of the or six is the output that will represent some and tree is the output that will represent Kenny so six is the output of the zuhr gift so here is the pin number six and we will connect a wire here up to this point six and three of the or gate so one two here is the pin number three

7.) Power and ground all the gates

8.)Next connect your x input from the full adder to QD of your first shift register

9.)Now connect your y input from the full adder to QO to the second shift register

10.) Connect your z input from the full adder to the Q on the flip-flop

11.) Connect your S output from the full adder to the SR input on the third shift register

12.) Connect your Cout output from the full adder to the D input on the flip flop

13.) Connect your ABCD inputs on the shift registers to the switches

14.) Connect your S1, S0, and CM from the first shift register to the second one

15.) Connect your CLk from the first shift register, to the second one, to the third shift register, and then the CLk input on the flip-flop

16.) Now connect your CM from the third shift register to a green led to a resistor and then which is then connected to power.

17.) Now connect your S1 from the third shift register to a green led to a resistor and then which is then connected to power.

18.) Now connect your S0 from the third shift register to a green led to a resistor and then which is then connected to power.

c) All apparatus:

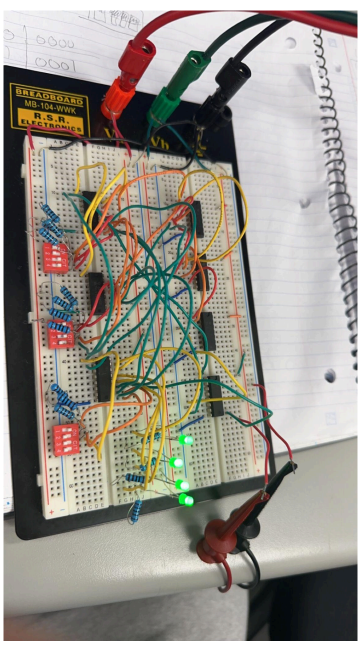
BreadBoard R.S.R Electronics: MB-104-WWK

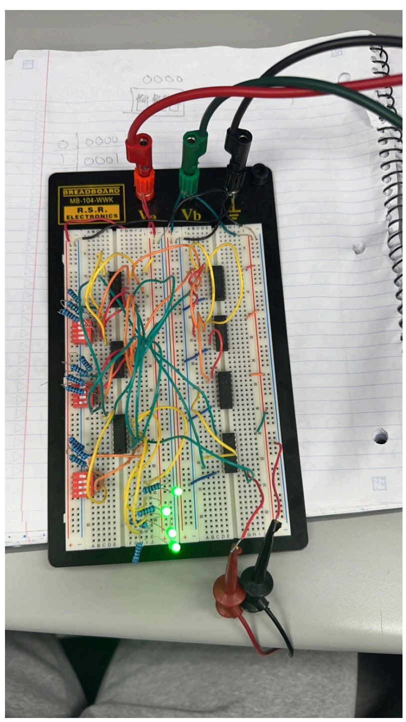
Keysight Power Supply: EDU36311A

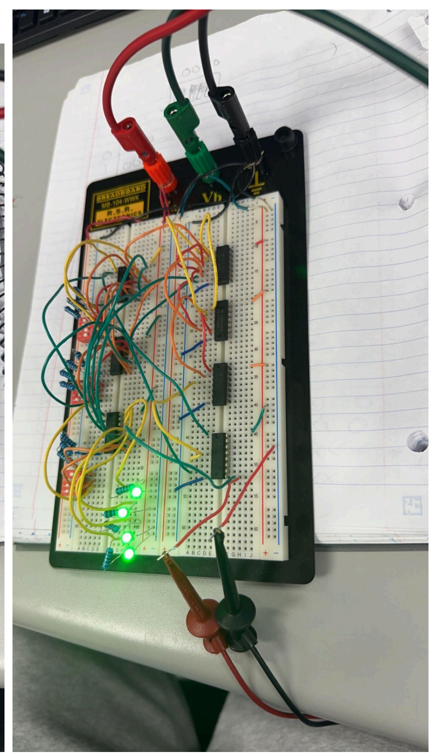
Digital Multimeter: DT820B

Keysight WaveForm Generator: EDU33212A

d) Results:







IV. Interpretation

a) Compare your results with the expected results.

Some of my results that I got when doing this experiment was when I had my first switch set to 0001, second switch set to 0001,third switch set to 01, and pressed trigger on the waveform generator multiple times it would shift right and output 0010 on the green leds which is 2. Everytime I tried to set my third switch to 10 to make it shift left, it wouldn't, even though I pressed the trigger on the waveform generator multiple times.

b) Answers to theoretical questions

1.) The shift registers are used for temporary data storage. They are also used for data transfer and data manipulation. These serial-in, serial-out, parallel-in, and parallel-out shift registers are used to produce time delay. Additionally, shift registers can be employed for memory expansion, effectively increasing available memory and storage space. Shift registers are also essential for implementing sequential operations like adders. This makes shift registers a versatile component in data processing and communication in digital circuits.

c) Discuss possible sources of error... ***<u>even if your experiment went perfect, there still needs to be a</u>***

discussion on error!

One of the errors I got in this lab was when I thought I finished properly wiring up the schematic given to everyone in the lab until I had to test it shifting right and left. My S1 and S0 that were connected from the shift register to the switch were mixed up and then resulted in the circuit not shifting correctly because my full adder worked when I tested it.

V. Conclusions

What I can conclude from this lab is given the concept of how shift registers work which is used for data transfer and applying it to a full adder you can create a simple multi-bit sequential adder to add two binary numbers either by shifting them to the right or left.

Post Lab Question