The City College of New York

Grove School of Engineering

EE 22100 – Electrical Engineering Laboratory I

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Lab Report Experiment # 7

Digital Clock

Instructor: Liang Yang

Student Name: Hasan Uchchas

Partner Name: Priscella Maria

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Objective:

The objective of the lab was to utilize various integrated circuits to design a 12-hour digital clock, to learn how to use a seven-segment numerical display and various types of counters and gates.

Introduction:

Digital Integrated Circuits (ICs) are used to implement a wide variety of logical, combinational, sequential, and other functions. In this lab, various ICs were used to implement the necessary logic for a 12 hour digital clock.

Equipment:

- Protoboard
- DC power supply
- Function Generator
- Digital Multimeter
- Oscilloscope
- 7-segment LED Displays

Integrated Circuits:

- CD 4543 – BCD-to-Seven-Segment Driver
- CD 4510 – BCD Up/Down Counter
- CD 4518 – Dual Up Counter
- CD 4081 – AND Gates

Task 1

We first connected two dual 7-segment displays to the CD 4543 decoder and then the CD 4543 decoder to the CD 4510 counter for the hour display following the schematics of the integrated circuit. We then connected the decoder to the hour counters.

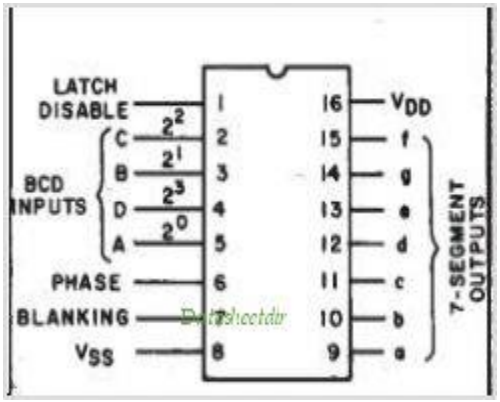

Figure 1. 4543 Decoder

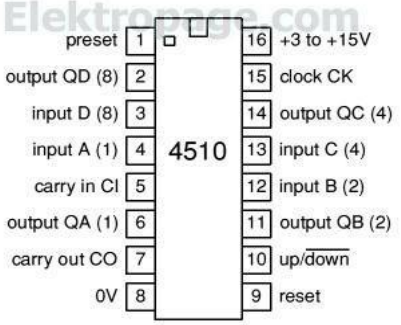

Figure 2. 4510 Counter

Task #2

Now we need the counters to count from 1 to 12 and then start from 1 again. In order to do so we had to implement a logic into out inputs. The hexadecimal code for the number 13 is 00010011. To reset the hour counters to 1 after they reach 12, we need to reset them when they reach 13. We connected the Q1 and Q2 of the first digit counter and Q1 of the second digit counter to two AND gates and connected the output to the Preset Enable of both the counters. In this way whenever all the three outputs will be 1, both counters will reset from whatever values that have been preset on the counters. We ground the presets of the second counter and put P1 to Vdd, so that it reset to 1. To implement the AND gates we used the CD 4081B chip

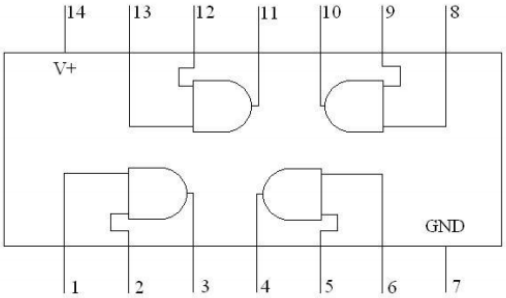

Figure 3. 4081B AND Series Gate

Task 3

Same procedure was followed to connect the minute and second digits to the 4543 decoders. Instead of using the 4510 counters, we used CD 4518 counters. These counters can control two digits simultaneously. We want the second digit to turn on when the first digit reaches 9. To cascade the two digits we connected the Q4 of the first digit to the enable of the second digit. This way the counters can count from 0 to 99.

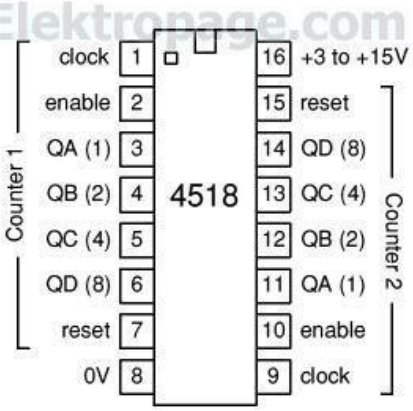

Figure 4. 4518 Counter

Task 4

For the minutes and seconds digits we need to reset them to 0 when they reach 60. The hexadecimal code for the number 60 is 0110 0000. Therefore we inputted Q2 and Q3 of the second digit into an AND gate. The output from the AND gate was connected to the Reset of the counters. In this way when Q2 and Q3 are 1, the counters are reset to 0.

Task 5

The output from the AND gate of the seconds counter was inputted to the clock of the minute counters and the output of the minute counter AND gate was inputted to the clock of the hour counters. A clock signal of 1 Hz with 5V Vpp was applied to the clock of the seconds counter.

Schematics

Here is the schematics of our clock.

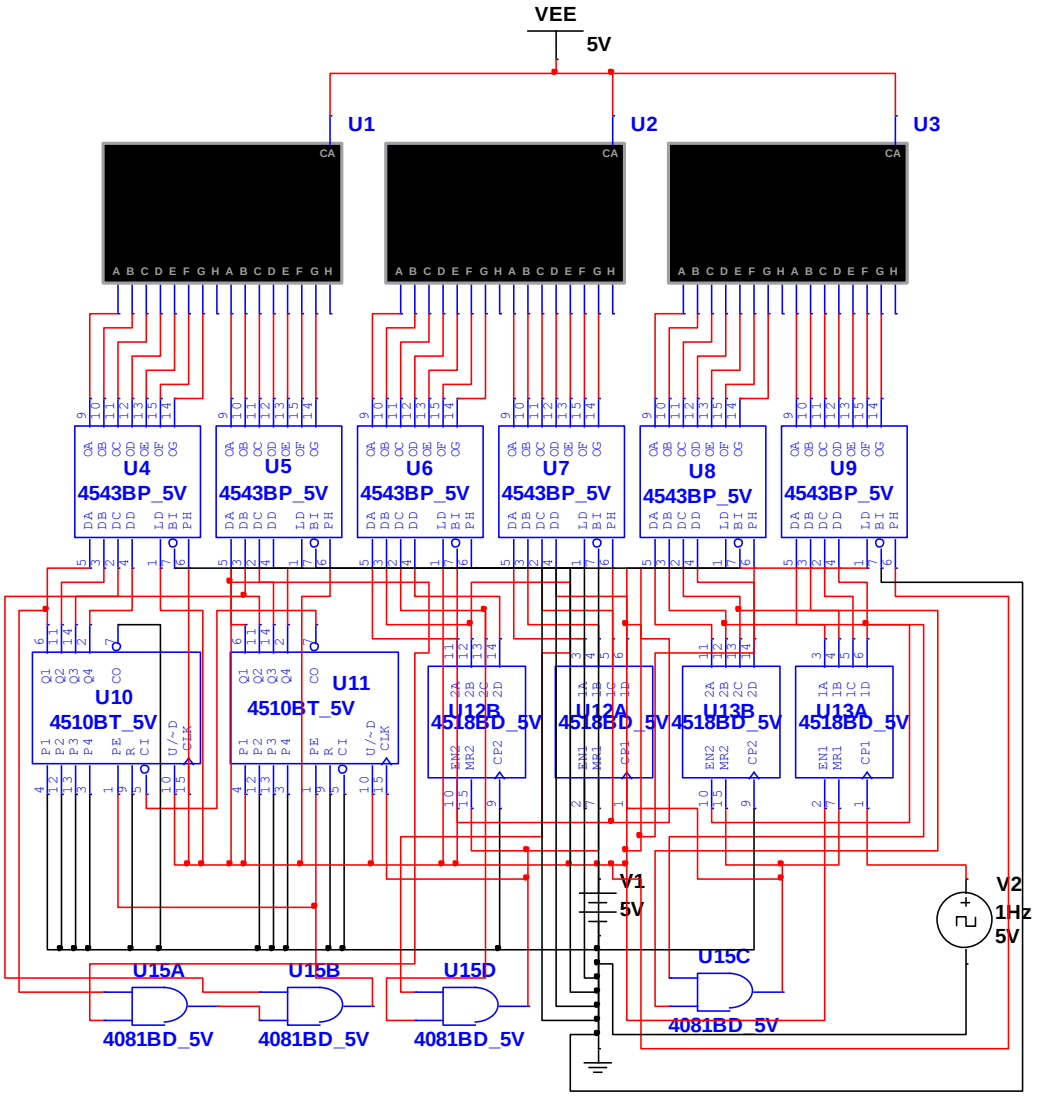

Figure 5. Digital Clock Schematics

Conclusion:

In conclusion this experiment allowed us to apply the knowledge we obtained through out the semester. We saw how tools like the oscilloscope; can help to test the circuit though out the experiment. By constantly checking the oscilloscope reading we can troubleshoot our circuit much faster. Troubleshooting our circuit gave us an idea how engineers develop techniques such as color coding which can help a lot when dealing with large amount of wires. We also used digital logic to get desired values on the LED display. By understanding how each component of our circuit works, we can think about how to modify our design to accomplish other goals. For example we can control a DC Motor with the 1Hz frequency. We can also use the LED display to show the results of a full adder.