Digital Logic Design Lab #4

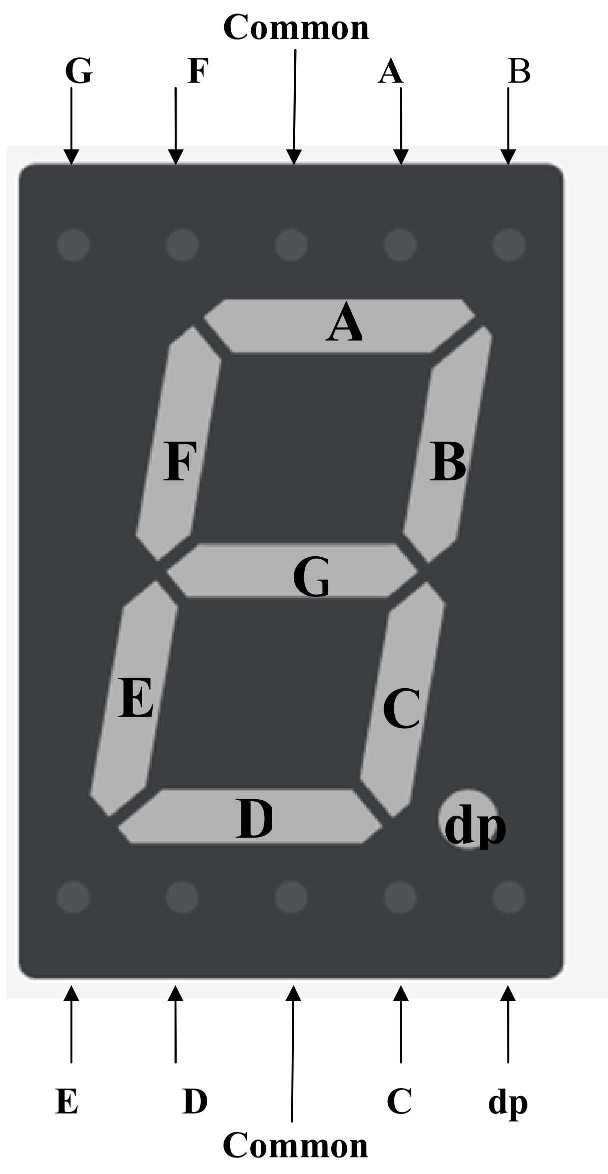
Objectives
Apply understanding of logic gates, medium scale chips and sequential design process to design, implement and test more complex digital circuits.

Preparation
Complete the following steps before starting to work on the experiments in this lab:

1) Complete lecture and assignment in Analyzing/Designing Combinational Logic Circuits Chapter
2) Complete Lab 3 and associated report

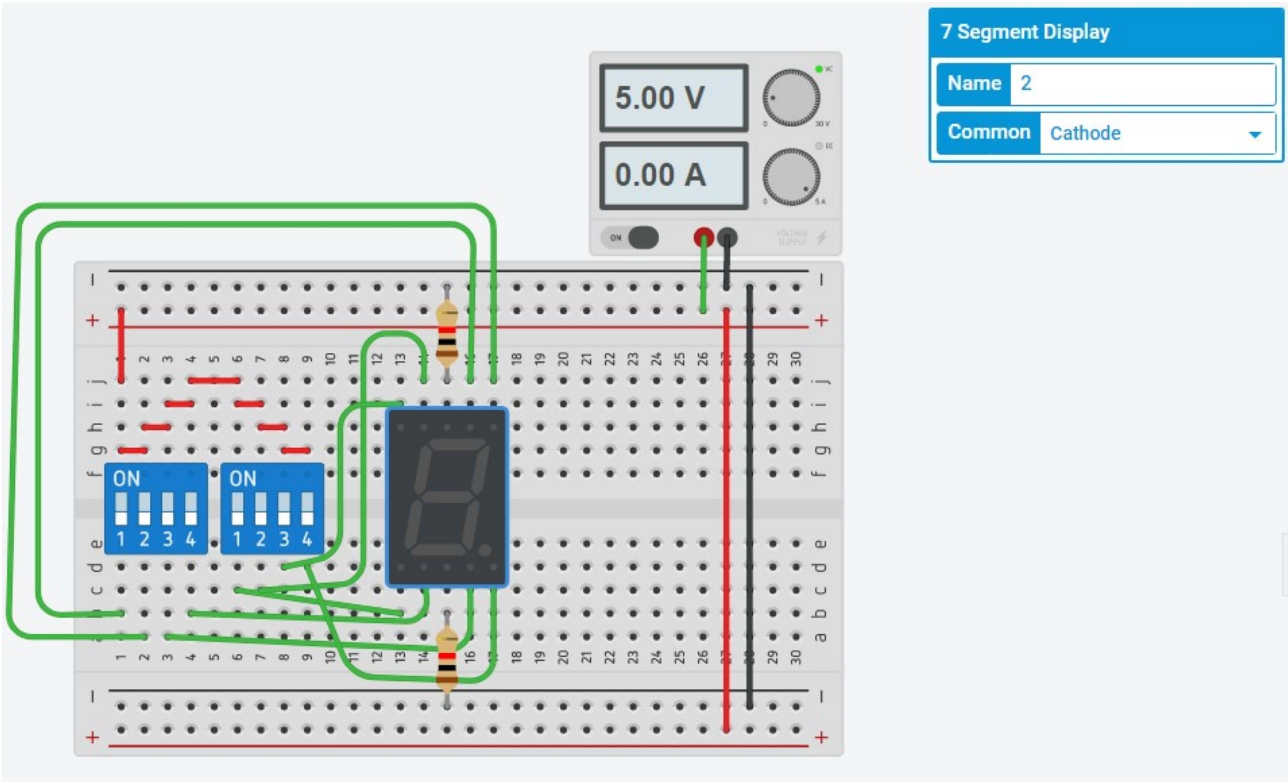
Experiment #1. 7-Segment Design

7-Segment displays as the name implies have seven segments that may be turned on individually to form an approximation to a given letter or number. Each of the 7 segments are labeled by letters "A" through "G". A typical Common Anode 7-segment displays is Lumex LDS-A304RI which is the default setting of the 7 Segment display model in TinkerCAD.

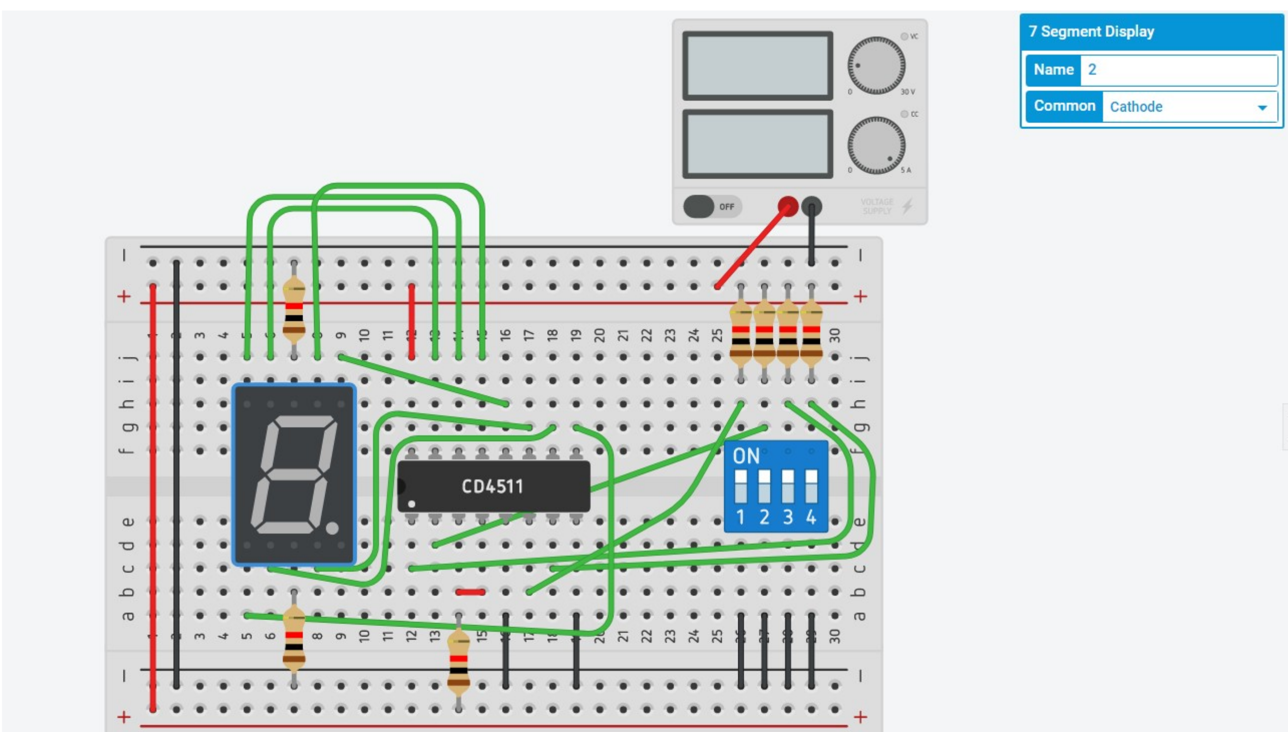


Notes: *If you plan to use CD 4511 display driver, you need to set the 7-segment display to "Common Cathode". In this mode commons are grounded and high voltage at inputs A-G will turn on the corresponding segment.*

a) Implement the following circuit in TinkerCAD and match the switch (left & right) numbers with the display segment letters (a-g).



b) Implement the following circuit in TinkerCAD using CD4511 (BCD to 7-segment display driver - common cathode). Simulate the circuit and generate a table that matches all binary equivalents of switch values (1 Msb … 4 Lsb) with observed numbers on the 7-segment display.



Experiment 2. 2-bit Adder

Design a 2-bit binary adder with carry. Your circuit should allow for two 2-bit binary input (a_1a_0 & b_1b_0) through switches and display the results of the addition in decimal format using the 7-segment display.

Complete the following steps:

1) Clearly identified independent variables (input) and dependent variables (output) for the 2-bit binary adder system.

2) Truth Table for the system based on defined input/output.

3) Write the minimize output functions in either POS or SOP using K-map. Clearly state the literal count and corresponding number of gates to implement each of the minimized output functions.

4) Using the results from previous part or your research into possible designs, draw a schematic to implement 2-bit adder with carry.
   Hints:
   * *Use Full-adder and half-adder design approach to simplify and modularize the design.*
   * *Use CD4511 seven-segment display driver to convert binary data to 7-segement display input.*

   "You are encouraged to use online research to understand these hints and take advantage of these hints"

5) Implement and test your design.

Report Requirements

This lab and associated report must be completed individually. All reports must be computer printed (formulas and diagrams may be hand drawn) and at minimum:

For each experiment include:

- Clear problem statement; specify items given and to be found.
- Answer experiment questions
- Resulting circuit schematics, simulation results, and other relevant information from the experiment.

For the whole report include:

- A Cover sheet with your name, class, lab and completion date.
- A Lessons Learned section which summarizes your learning from this lab.
- A New Experiment section that has description of a new experiment and the experiment's results. Experiment should be related to material covered in class but not similar to one of the experiments in this lab.