

W4B: DE 2.3.2 Seven-Segment Display

Introduction

What do digital clock displays, basic calculators, shot clocks all have in common? In addition to being built from electronics, many also include a **seven-segment display** (SSD) as part of their design.

There are two types of seven-segment displays: **common cathode** and **common anode**. Understanding how these displays work and the differences between them is fundamental to designing many different types of electronic devices.



In this activity, you will learn how to use a seven-segment display to display both alpha and numeric characters. You will also be introduced to the SSD driver.

Equipment

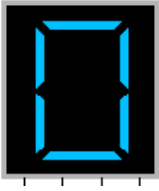




Computer with Circuit Design Software (CDS)

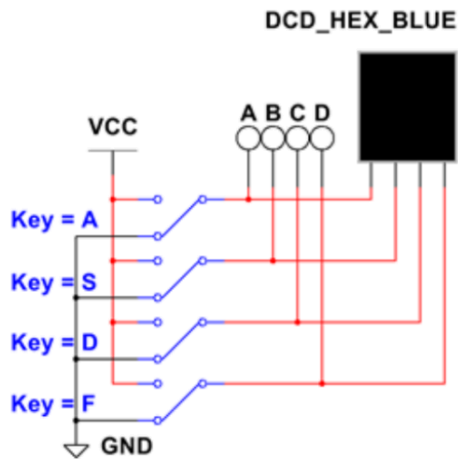
Procedure






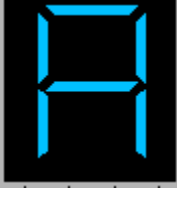
- a. Useful tools in simulations are digital displays that can display numbers or letters. One such tool is the digital hexadecimal display or DCD_HEX. It has a built-in decoder that converts a binary number to its corresponding hexadecimal display digit. For example, an input of "0110" would display a "6" and a "1010" would display an "A".






Four-Digit Display

Create the following circuit in the Circuit Design Software (CDS) and complete the truth table in your notebook.

	A	B	C	D	Display
1	0	0	0	0	
2	0	0	0	1	
3	0	0	1	0	
4	0	0	1	1	
5	0	1	0	0	



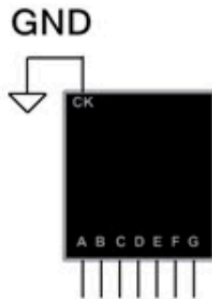
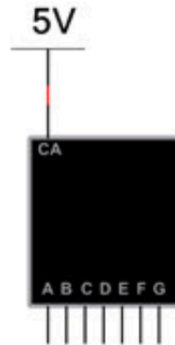
6	0	1	0	1	
7	0	1	1	0	
8	0	1	1	1	
9	1	0	0	0	
10	1	0	0	1	
11	1	0	1	0	

12	1	0	1	1	
13	1	1	0	0	
14	1	1	0	1	
15	1	1	1	0	
16	1	1	1	1	

Seven-Segment Display

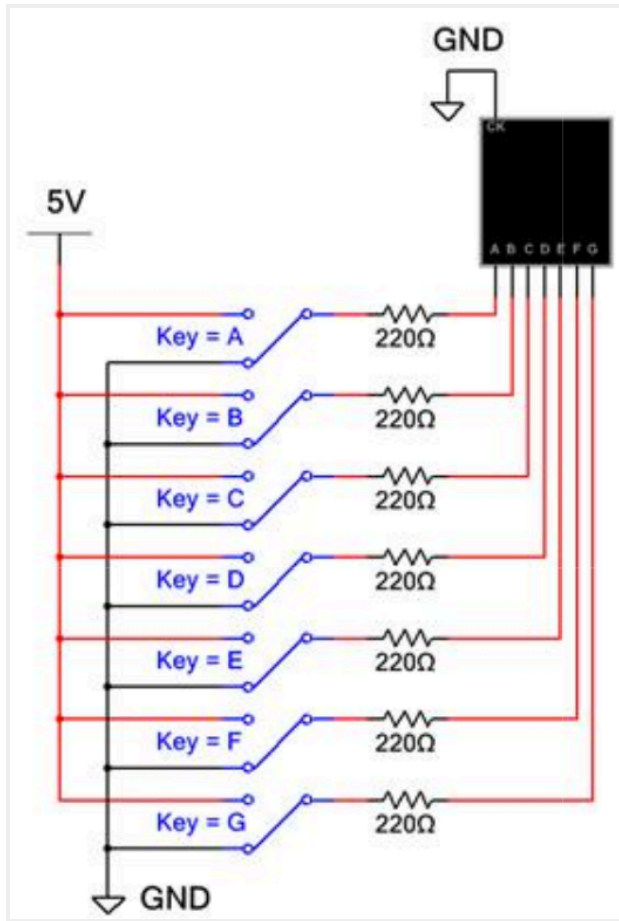
Similar to the four-input digital hex display is the seven-input seven-segment display.

Investigate what alpha-numeric characters we can display on a seven-segment display.

Common Cathode**Common Anode**

Using the CDS, create the common cathode seven-segment display test circuit shown below.

Note: The seven-segment display must be configured as a common cathode display.



- b. For the seven switches (A through G), determine the settings required so that the seven-segment display will display 0–9. Use the results to complete the table below in your notebook.

Display	A	B	C	D	E	F	G
0	1	1	1	1	1	1	0
1	0	1	1	0	0	0	0
2	1	1	0	1	1	0	1
3	1	1	1	1	0	0	1
4	0	0	1	1	0	1	1

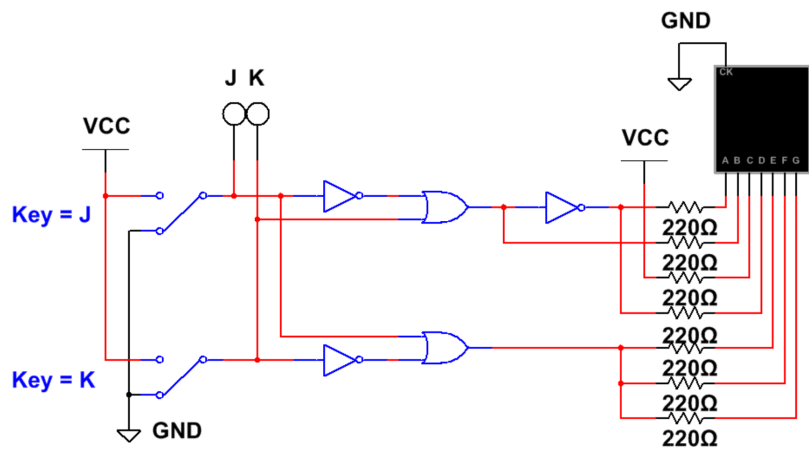
5	1	0	1	1	0	1	1
6	1	0	1	1	1	1	1
7	1	1	1	0	0	0	0
8	1	1	1	1	1	1	1
9	1	1	1	1	0	1	1

- c. Using the seven SPDT switches (A through G), determine at least 10 alpha characters that you could display using the seven-segment display. Don't forget to include lowercase characters. Record your findings in your notebook.

Display	A	B	C	D	E	F	G
A	1	1	1	0	1	1	1
b	0	0	1	1	1	1	1
C	1	0	0	1	1	1	1
d	0	1	1	1	1	0	1
E	1	0	0	1	1	1	1
F	1	0	0	0	1	1	1
S	1	0	1	1	0	1	1
u	0	0	1	1	1	0	0
o	0	0	1	1	1	0	1
P	1	1	0	0	1	1	1

3. Now, let's see how you can use a seven-segment display in a logic circuit to create different letters and display a message.

- Analyze the seven-segment display circuit below and complete the display table. The display is a common cathode.
- What message do you predict will be displayed?

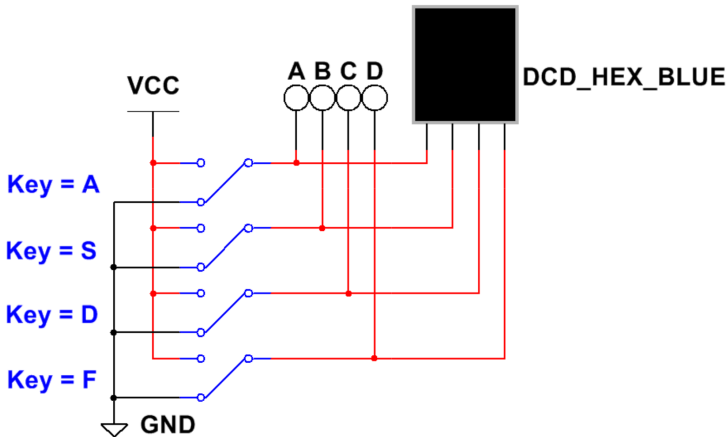


J	K	Display
0	0	H
0	1	1
1	0	6
1	1	H

c. Simulate the circuit to see if you were correct with your analysis.

Correct.

Recall the digital hex display that translates four binary inputs into hexadecimal.



4. To display numbers on a seven-segment display, you need to use a specific driver that will translate four binary inputs into seven-segment numerical code.

- The 74LS48 SSD Driver is designed for the Common Cathode SSD.
- The 74LS47 SSD Driver is designed for the Common Anode SSD.

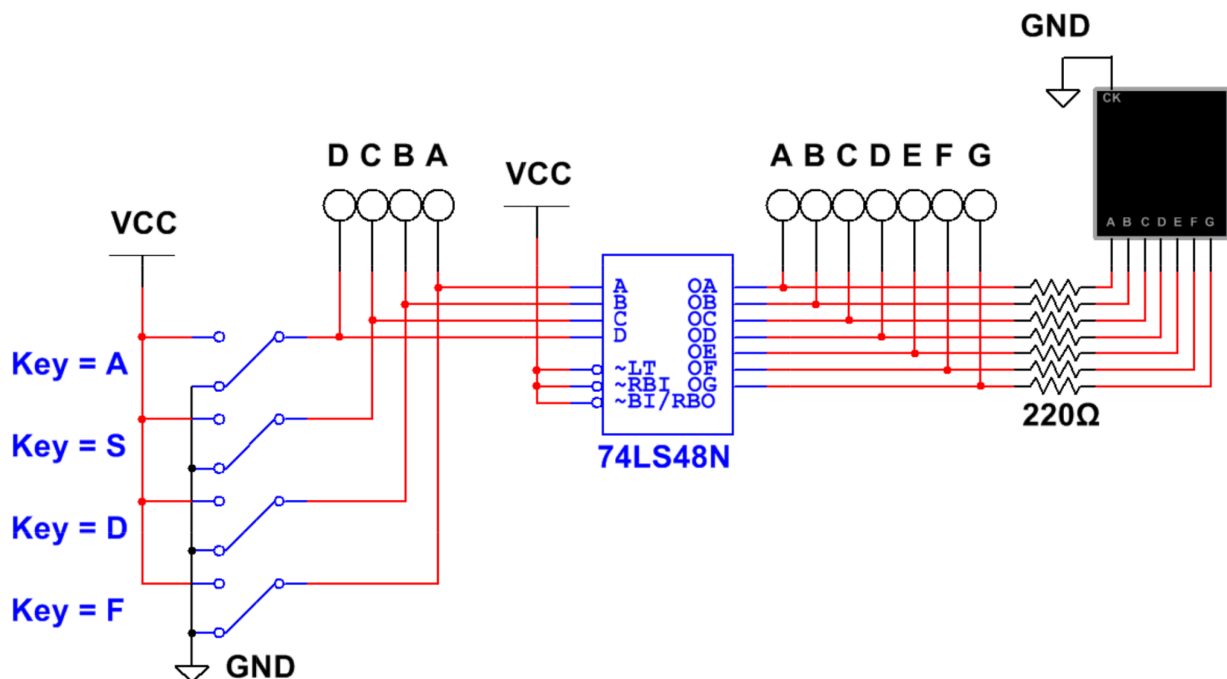
Simulate the circuit shown below.

- a. If output OA is on "high", is segment A on or off?

ON

- b. Enter 0000_2 to 1111_2 and note the output on the SSD. How is it different from what is displayed on the Digital Hex Display, especially after decimal 9?

It starts to output nonsense, it is evident that the 74LS48N chip is only designed to output numbers 0-9.



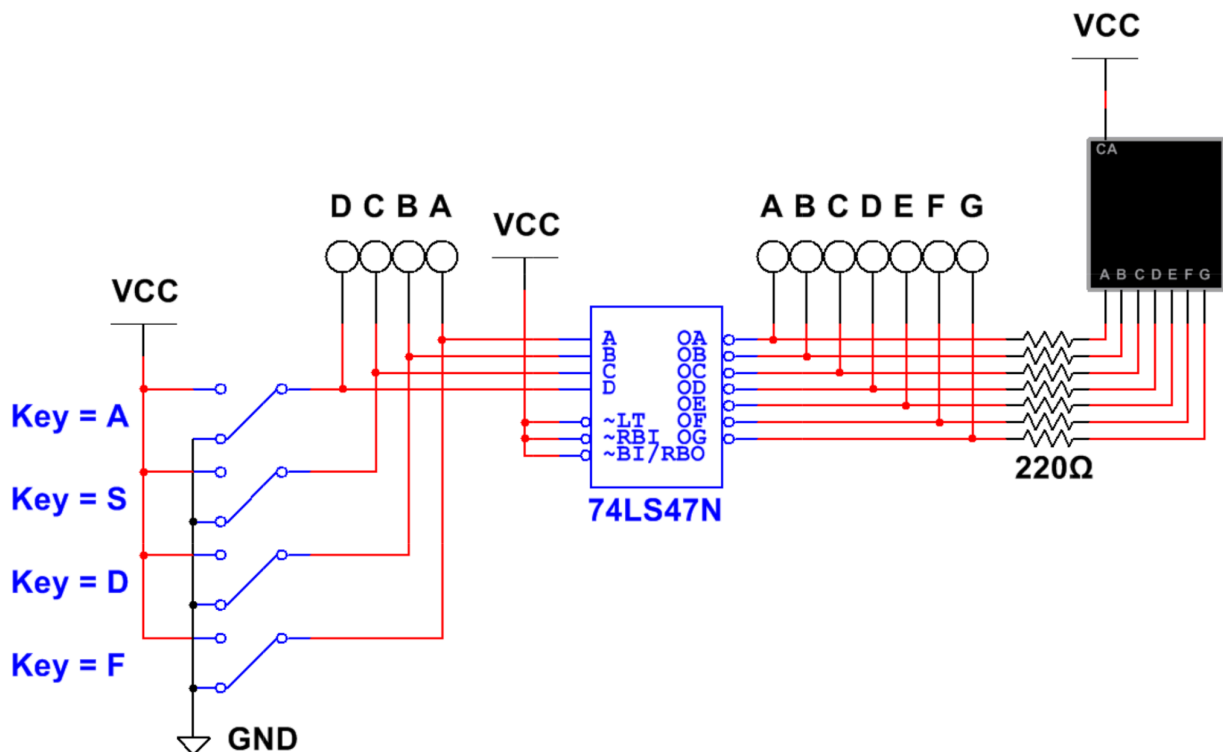
5. Using the CDS, simulate the 74LS47N SSD Driver with Common Anode SSD.

a. If output OA is on "high" is segment A on or off?

On

b. Enter 0000_2 to 1111_2 and note the output on the SSD. What is the major difference between a Common Cathode Display with the 74LS48 and a Common Anode Display with the 74LS47?

After decimal 9, both chips, 74LS48 and 74LS47, start to output nonsense.



6. Consider the Common Anode Seven-Segment Display with a 74LS48 SSD Driver.

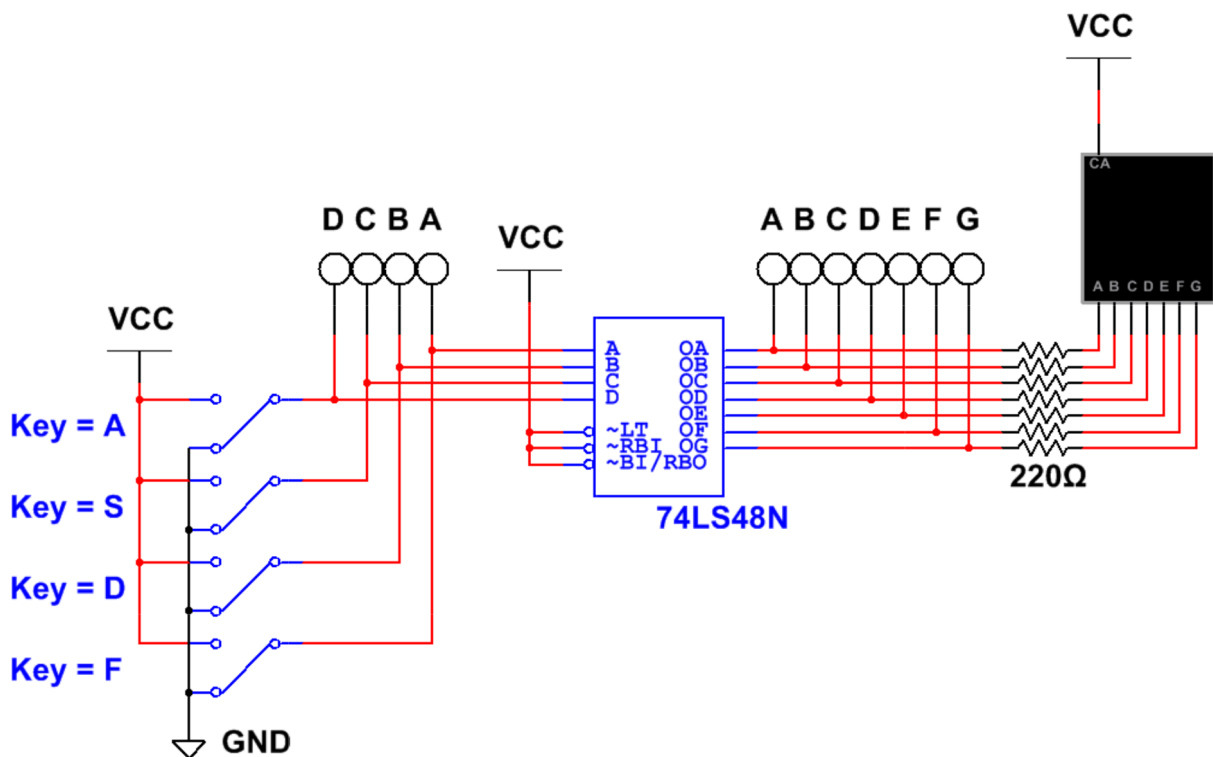
- a. What if you only had access to a Common Anode Seven-Segment Display with a 74LS48 SSD Driver?

Add inverters.

- b. Could you modify the circuit to display the decimal numbers correctly?

Yes, Add inverters.

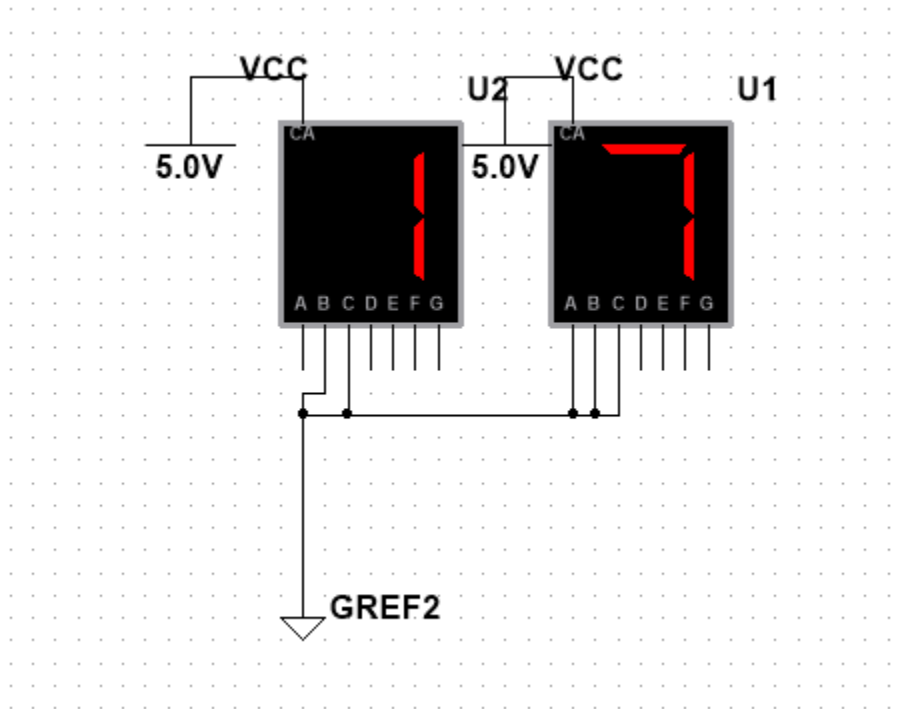
- c. Using the CDS, simulate the modified circuit using a CA SSD and 74LS48 SSD Driver to display the decimal numbers correctly.



Conclusion

Answer in complete sentences each of the questions below.

1. Complete the wiring of the seven-segment displays shown so that they will display your age. If you are 15, display a 1 on the common cathode display and a 5 on the common anode display.



2. List five words of three characters or more that you could spell out using a seven-segment display. Don't forget about lowercase letters. Be creative. Be polite.

- CAD
- COD
- Err
- bAll
- CAI

3. Describe what you should look for if you designed a circuit with an SSD that appears to work in simulation, but does not appear to be working when you create the circuit. (Hint: It may actually be working.)

Check whether or not you have the correct chip for the seven segment display type you have (common anode or cathode).