San Francisco State University
School of Engineering
ENGR 206

Project 1: LED's and Integrated Circuits

Objective

Investigate the properties of Light Emitting Diodes (LED's) and how they can be combined to form a 7-segment display.

Investigate a popular integrated circuit called the 555 timer. Learn how to configure the timer in astable mode and how to calculate timing parameters.

Light Emitting Diode (LED)

Size: T1
Typical Current Rating: 20 mA

LM555 Timer

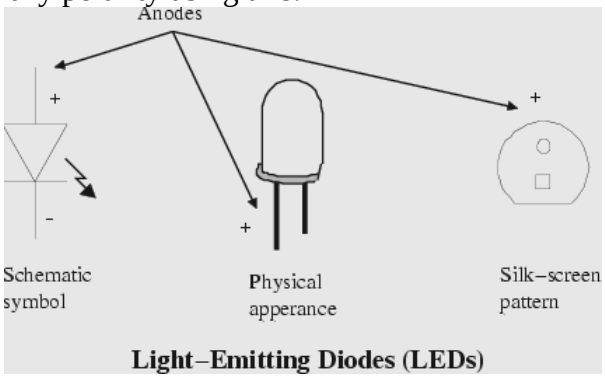
Lab Exercise

Light Emitting Diodes (LED)

1. Determine Polarity of the LED

    a. Using 12-volt DC power supply and a 1k ohm resistor in series with the LED, determine the anode (+) and the cathode (-) of the device. <u>The LED must ALWAYS have a resistor in series to limit the current (or some other means), otherwise it will be destroyed.</u>

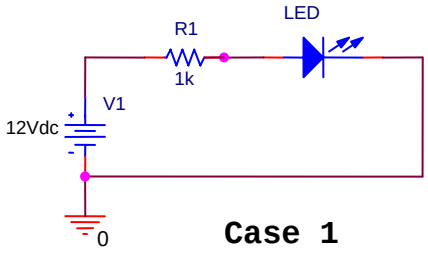
    b. Note that one lead of the LED is longer and that there is a flat spot on the casing. Identify polarity using this.



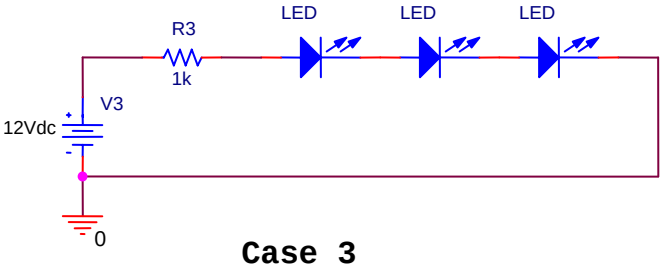
Light–Emitting Diodes (LEDs)

2. Measure the voltage drop across each LED and the current through the circuit for the four cases. Note the relative brightness of the LED for each case.

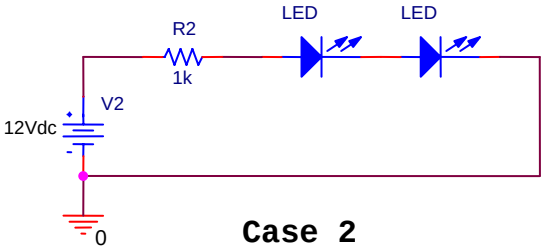
3. Calculate and verify the resistor value needed in place of the 1k resistor for a current of 20mA in the LEDs for each case.



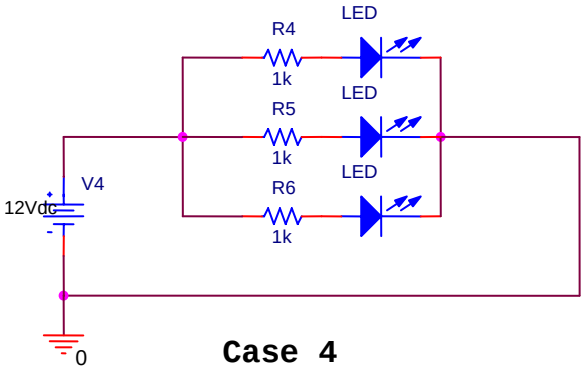
Case 1



Case 3



Case 2



Case 4

7-Segment LED Display

1. Figure 1 below shows a typical 7-segment display with each element in the display assigned a letter, a through g. Clearly, the task in using these displays is to light the appropriate displays to represent a given digit. For example, to display a '0', you would light segments a, b, c, d, e, and f.

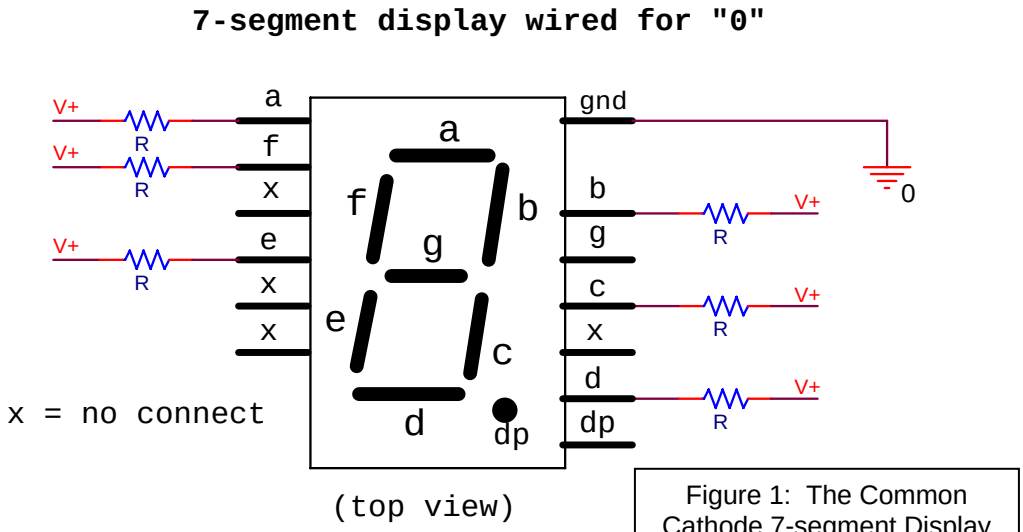


Figure 1: The Common Cathode 7-segment Display

2. In addition, these displays come in two types: ***Common Cathode*** and ***Common Anode***, depending on their interior wiring. See figures 2 and 3.

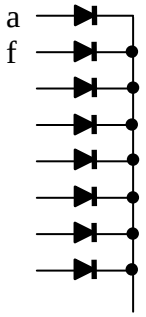


Figure 2: Interior wiring diagram for a Common Cathode (CC) display

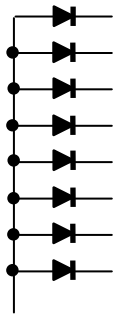


Figure 3: Interior wiring diagram for a Common Anode (CA) Display

3. Note that the main difference between the two displays is in the direction of the current flow. In the CC display, all LED segments share a common negative terminal, which should be tied to ground. Therefore, the logic that drives the display must supply current **(limited by a resistor)** to each segment. On the other hand, the CA display segments share a common positive terminal, which would be attached to the voltage supply. Each segment is then connected to a point in a digital logic circuit that will have to sink the current from each segment.

4. Using the figure above for the 7-segment common cathode LED display, calculate the resistor needed for an LED segment using a 12-volt power supply, such that each LED segment draws 20mA .

5. Wire up the 7-segment display to make the numbers “3”, “4”, and “5”. Always use a resistor for each segment that is used to create the number. What segments are used for each number?

Integrated Circuit: LM555 Timer

1. Using the data sheet, determine the pin numbers of the 555 timer and each pin designation.

2. Determine the supply voltage limits. Can you use the timer with 3 volts? With 24 volts?

3. Determine the supply current (what the 555 timer consumes to operate).

4. Determine the allowable power dissipation.

5. Knowing the allowable power dissipation, calculate the maximum current allowable at the output using a 12-volt supply. What is the maximum number of LED's you can blink?

6. Astable operation of the 555 timer: using the data sheet, pick the capacitor and calculate resistor sizes for 1-Hz. Do not use a resistor greater than 1 megohm.

7. Connect 555 timer in astable mode for 1-Hz operation and connect LED’s with resistors to the output of the timer as shown in the diagram.