Laboratory Goals

- Familiarize students with the LM 555 IC and its uses
- Design a free-running oscillator
- Design a triggered one-shot circuit
- Compare actual to theoretical values for the circuits

Pre-lab reading

- *Student Reference Manual for Electronic Instrumentation Laboratories* by Stanley Wolf and Richard Smith, Copyright 1990
- *National Semiconductor LM555 Data Sheet*, *found on the website*

Equipment needed

- Lab notebook, pen
- Agilent E3631A Power Supply
- Agilent 34401A Digital Multimeter
- Agilent 54622 Digital Oscilloscope
- Agilent 33120A Function Generator
- 2 oscilloscope probes (attached to the oscilloscope)
- 1 test lead, BNC/EZ Hook
- 1 test lead, red, banana/EZ Hook
- 1 test lead, black, banana/EZ Hook

Parts needed

- Circuit breadboard
- Lab parts kit
- IC, Timer/Oscillator, LM 555
- Capacitors, 2, ceramic disc, 0.01μF
- Capacitor, electrolytic, 68μF
- Resistors, 1KΩ, 180Ω, ¼ Watt
- Resistors, 3, (values to be determined), ¼ Watt
- Red LED
- Jumper wires

Lab safety concerns

- Make sure all circuit connections are correct, and no shorted wires exist.
- Adjust the power supply to the proper voltage before connecting it to the circuit
- Adjust signal generator to the proper level before connecting it to the circuit

1. Pre-Lab LM 555 Designs

Refer to the National Semiconductor LM555 Data Sheet, found on the website

- Design an astable multivibrator (free-running oscillator), referring to Figure 1 below. Choose the oscillation frequency to be the last 4 digits of your student ID number, and **C** to be .01 µF. Design the oscillator for a pulse width (PW) of .60 (60%).

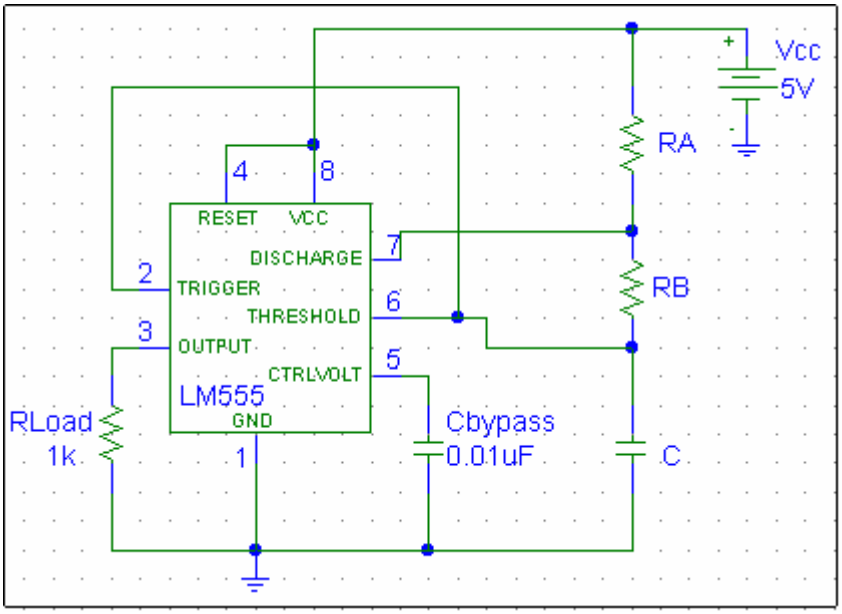


Figure 1 – LM555 Free-running Oscillator Schematic

- Design a monostable multivibrator ("one-shot"), referring to Figure 2 below. The hold time (i.e., the amount of time the circuit will hold its output in a high state) will be 1 second, and will light a Light-Emitting Diode (LED). Choose **C** to be 68μF.
    - Calculate the current through $\mathbf{R_d}$, which is the same as the current through the LED. Assume the LED to have a 1.5-volt drop, and the output of the 555 to be the same as Vcc.
    - We will use an electrolytic capacitor for **C**. Be careful to note the polarity. The negative terminal of the capacitor must be connected to the circuit ground. Electrolytic capacitors must be installed correctly or they may explode or leak.
    - The flat side of the LED (cathode) goes to circuit ground.

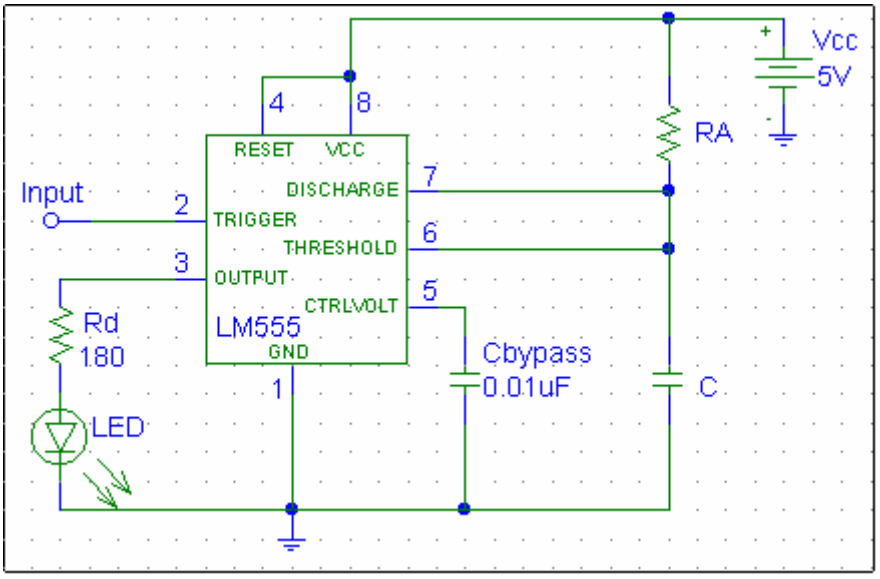


Figure 2 – LM555 "One-shot" Schematic

2. Circuit 1 Construction and Signal Measurement

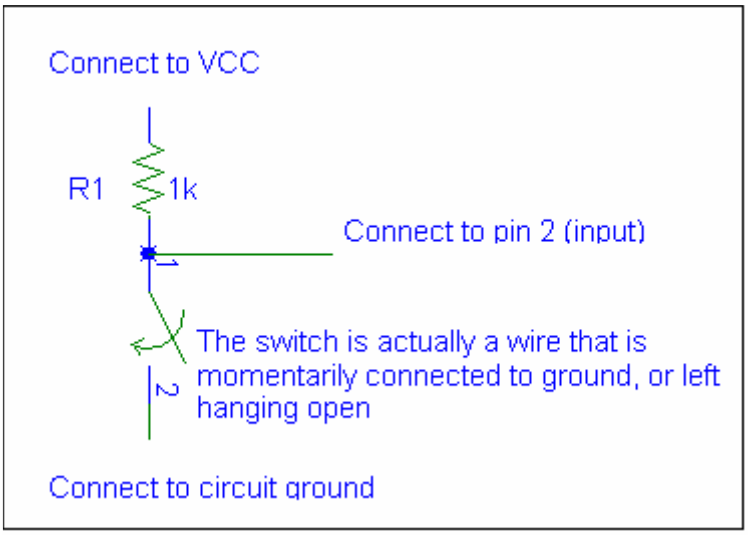
- Before building the circuit, measure the values of all passive components (resistors and capacitors) and record the values in your lab notebook
- Build circuit 1 using the schematic (Figure 1), and your values of $\mathbf{R_A}$, $\mathbf{R_B}$, and **C**. Resistors are probably not available in the calculated values: Use the nearest standard value found in the cabinet.

- Adjust the power supply to 5V, then connect it to the circuit Vcc and ground connections
- Connect the CH 1 oscilloscope probe and ground clip to the circuit output and circuit ground respectively
- Measure the output signal of the circuit. Record the pulse width, pulse period, frequency, amplitude, rise time, and overshoot in a table in your lab notebook
- Copy the output waveform to a diskette using the **Quick Print** option on the oscilloscope

- Disable the power supply output
- Disassemble the circuit

3. Circuit 2 Construction and Signal Measurement

- Build circuit 2 using the schematic (Figure 2), and your values of $\mathbf{R_A}$ and **C**
- Attach the following input trigger circuit to pin 2:



- Connect the power supply to the circuit (still at 5VDC)

- Test the one-shot circuit by touching the wire to circuit ground several times within 1 second. (Notice that the LED remains lit for about 1 second, regardless of the number of times you touch the wire to circuit ground within 1 second)

- Disable the power supply output
- Disassemble the circuit

Before leaving the lab, take a few minutes to make sure all equipment and test leads are returned to your cabinet, and that you have cleaned up your work space.

4. Analysis

Write a summary report for this lab. Be sure to also include the following topics:

Compare theoretical vs. measured values, and calculate the percent error. Why might you see differences?

What applications can you think of to use these circuits?

Why is there a resistor in series with the Light Emitting Diode?

Explain any difficulties you had with this lab. (Please include suggestions to improve the lab, if you have them).