THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
Department of Electronic and Computer Engineering
ELEC 1100

Laboratory 3: Pulse Generation (5%)

A) Objectives

- To generate pulses from a constant supply.

B) Equipment

- NE555 Timer, 74HC14 Schmitt-Trigger Inverter.

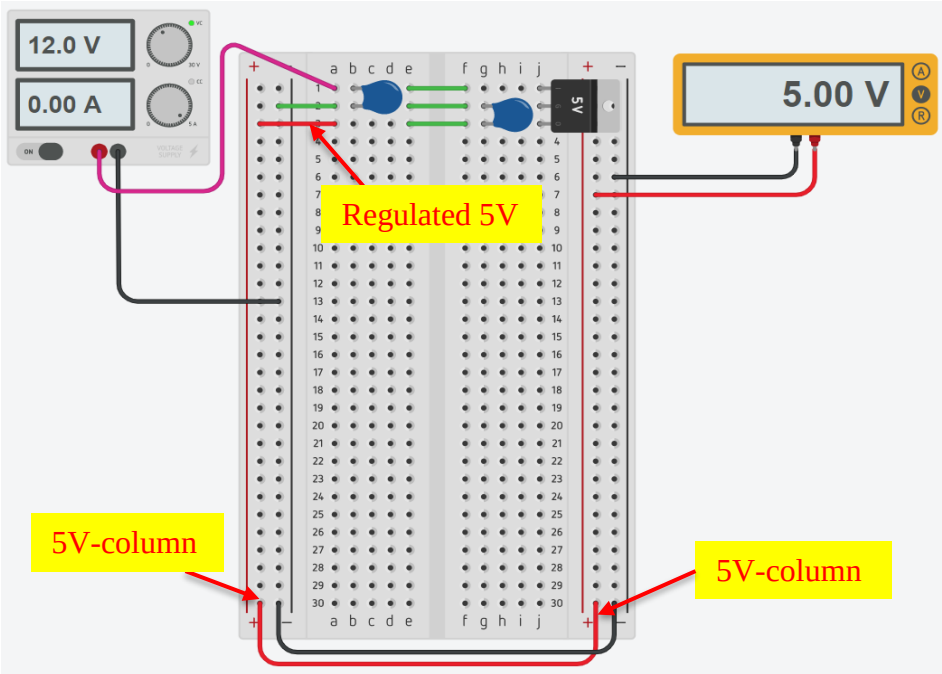
C) Tinkercad Simulation Part

Reminder: Find "Breadboard Small" in Tinkercad to build each simulation circuit on it.

Simulation 1: Review of LM7805 Circuit [Lab#03_S1]

Step 1: Create a new circuit in **Tinkercad** and change the circuit name.

Step 2: Refer to Lab#02, rebuild the LM7805 regulator circuit as below (no need of adding LED and resisror). Set the regulated 5V (output of LM7805) to both of the 5V-columns on the breadboard.



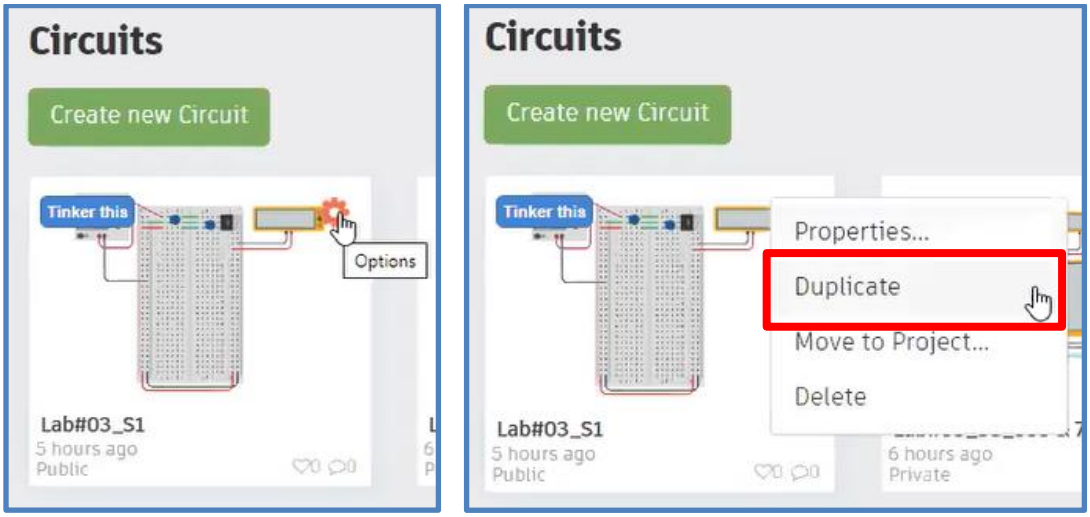
Step 3: Use multimeter to confirm the voltage value of the 5-column at the right side of the breadboard.

****** TA Check 1: Show your TA the multimeter reading of 5V.**

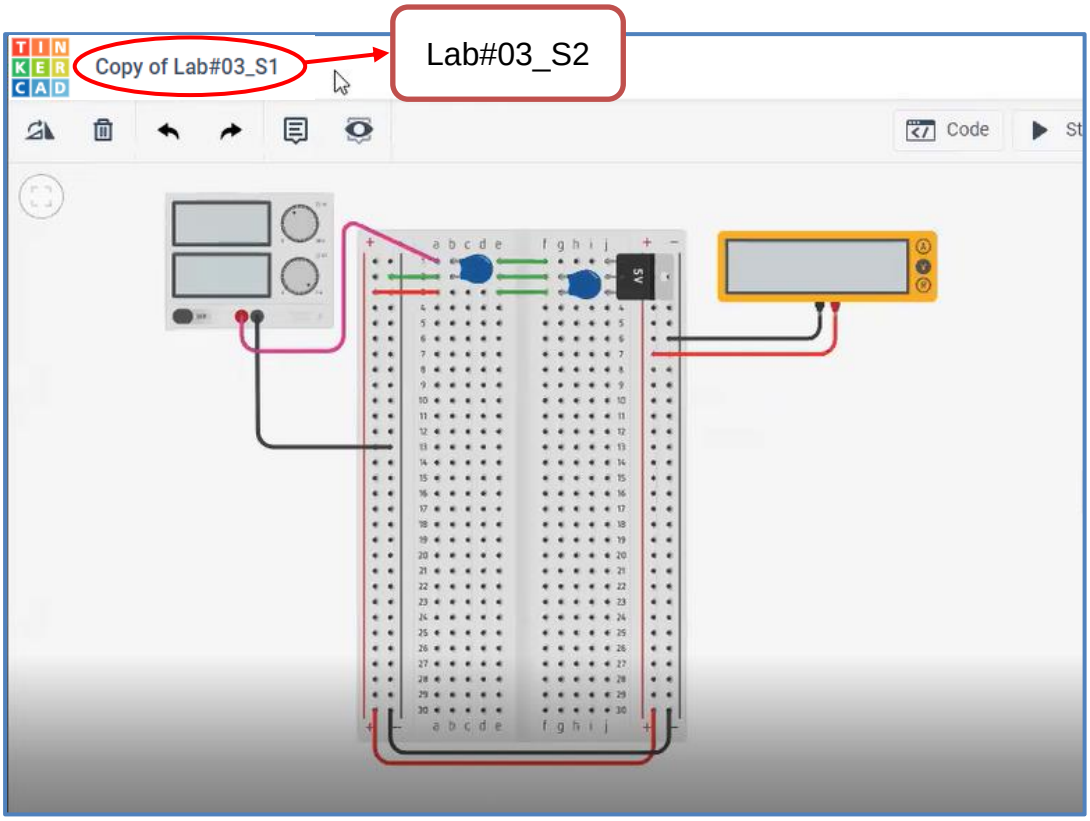
Simulation 2: Constructing a pulse generator with a NE555 Timer **[Lab#03_S2]**

Step 1: Click the Tinkercad logo to go back to dashboard. You shall see your circuits thumbnail appears. The most recently revised work should be on top, i.e. your "Lab#03_S1" circuit as you just completed it in Simulation 1.

Step 2: Move your mouse pointer over the thumbnail of "Lab#03_S1" (the re-arranged LM7805 regulator circuit), an Options icon ⚙ will appear on the top right corner. Click it and select "Duplicate".



Step 3: A new circuit is created as "Copy of Lab#03_S1". Change the circuit name to "Lab#03_S2".

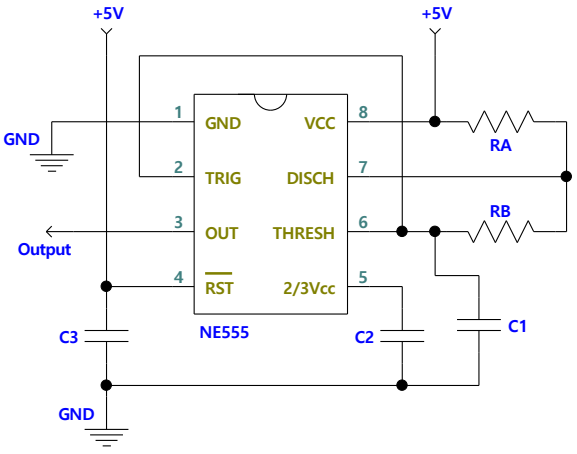


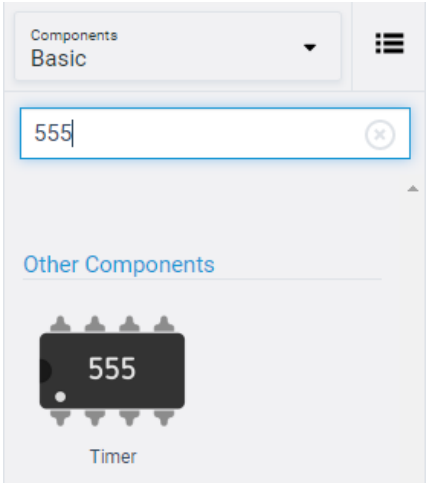
Note: For this circuit simulation, you need to put your timer circuit below the LM7805 regulator circuit on the breadboard (You may refer to Tutorial notes for the breadboard arrangement).

Step 4: Find "555 Timer" in the instrument list and construct the circuit shown below with the component values below.

$$R_A = 30k\Omega,\ R_B = 10k\Omega,\ C_1 = C_2 = C_3 = 0.1\mu F$$

Note that the 5V should be from the LM7805 regulator output, i.e. 5V-column on the breadboard.





Step 5: Use Oscilloscope to observe the output at pin 3 of the NE555. You may need to change the "Time Per Divison" to "1ms".

****** TA Check 2: Show the generated pulse (at least two completed peirods) on Oscilloscope to your TA**

Q1: With the formulae given below, what should be the theoretical (calculated) frequency and duty cycle of the pulse signal generated? (Show your calculation)

Clock High Time = $0.7\ (R_A + R_B)\ C_1$

Clock Low Time = $0.7\ (R_B)\ C_1$

Period = $0.7\ (R_A + 2R_B)\ C_1$

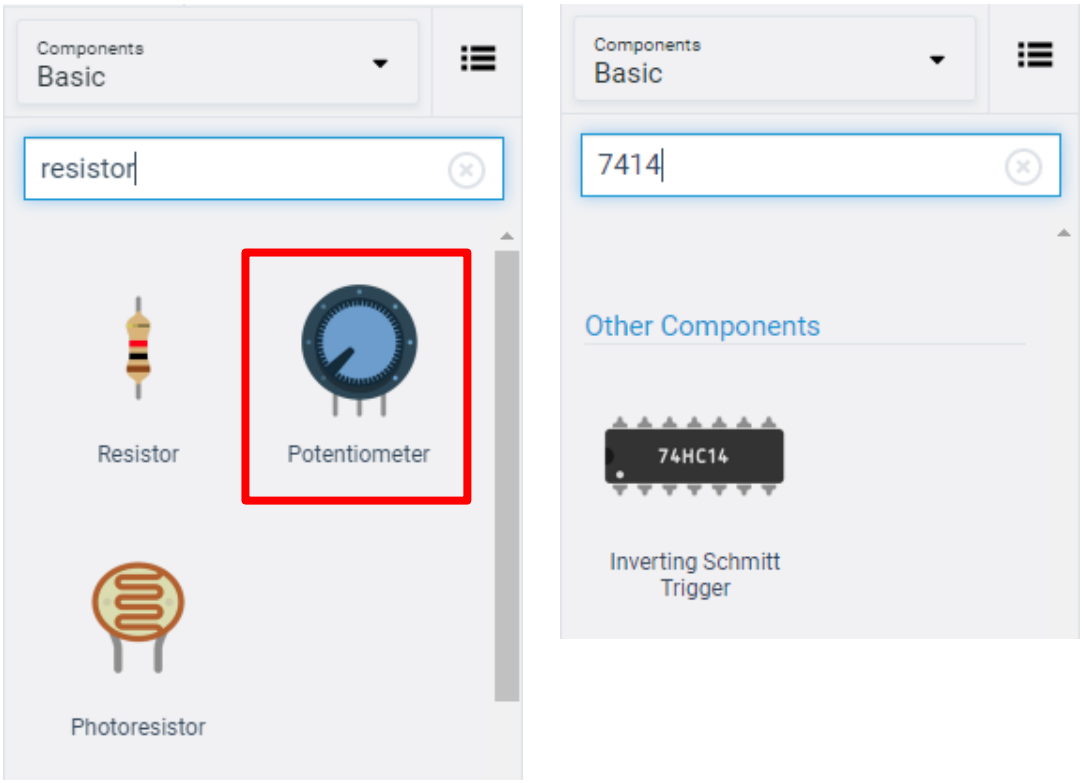
Simulation 3: Constructing a Schmitt Trigger circuit **[Lab#03_S3]**

Note: For this circuit simulation, you need to put your Schmitt Trigger circuit below the 555 Timer circuit on the breadboard (You may refer to Tutorial notes for the breadboard arrangement).

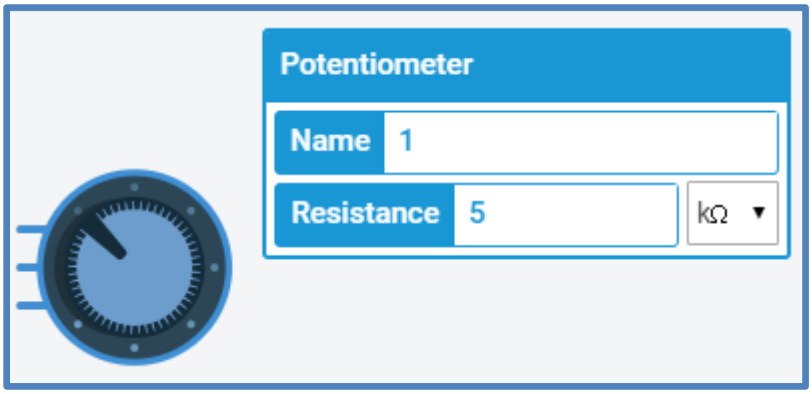
Step 1: Duplicate your "Lab#03_S2" circuit and change its name to "Lab#03_S3".

Step 2: Find the "Potentiometer" (variable resistor) in the instruments list.

Step 3: Find the 74HC14 "Inverting Schmitt Trigger" in the instruments list.



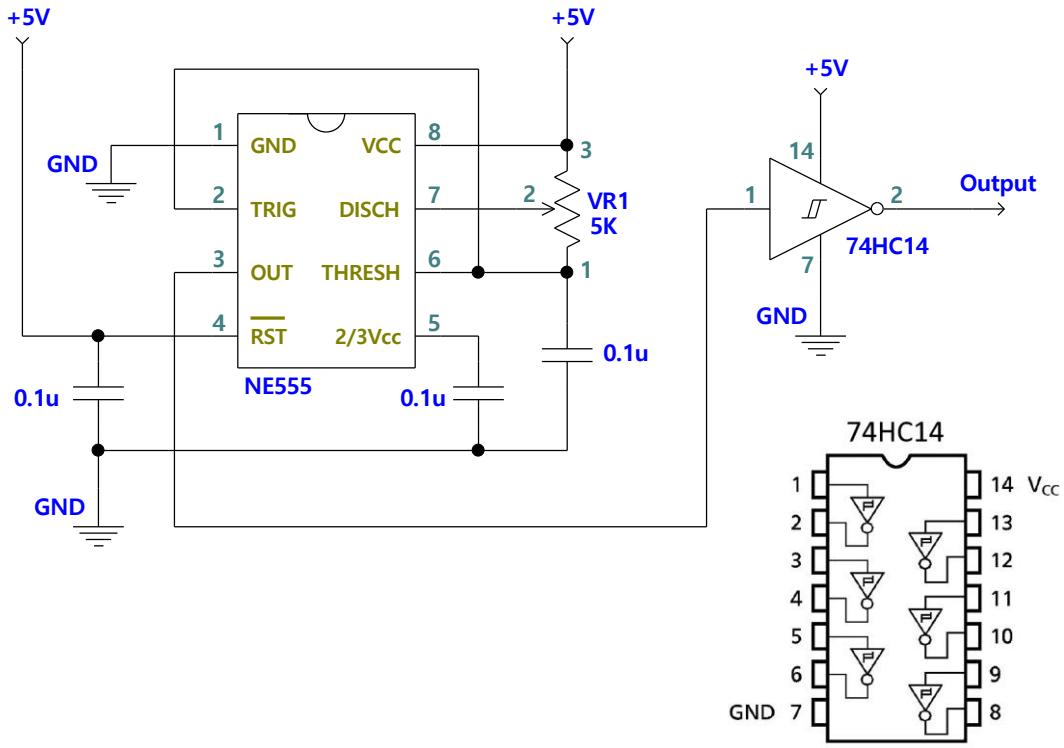
Step 4: Set the "Resistance" (total resistance) of the "Potentiometer" to 5kΩ.



Step 5: Connect the 74HC14 "Inverting Schmitt Trigger" to the timer output (Pin 3 of 555 Timer) as shown at next page.

Step 6: Replace the resistors R_A and R_B in Simulation 2 with the “Potentiometer”.

Step 7: In this experiment, you need two Oscilloscopes. Use Oscilloscope 1 to measure Pin 3 of 555 Timer and Oscilloscope 2 to measure Pin 2 of 74HC14.



Step 8: Click and turn the “Potentiometer” (variable resistor) to re-assign the resistance into the two parts, until at least two completed periods shown on the Oscilloscopes. You may need to change the “Time Per Divison” to “0.1ms”.

****** TA Check 3: Demo to your TA the waves on the two Oscilloscopes (at least two compelted periods).**

Step 9: Notice the difference between the waveforms on Oscilloscope 1 and Oscilloscope 2. Answer below question in your summary sheet.

Q2: What is the difference between the waveforms? (indicate the function 74HC14)

Remember to change the circuit names and copy share links of your **Simulations 1-3** to the table in your summary sheet.