The Chinese University of Hong Kong
Department of Computer Science and Engineering
CENG2030 Fundamentals of Embedded System Design

Lab 3: Instrumentation and Measurement

Submission Instructions:

- Save all the circuit files in .TSC, which you created in the lab
- Answer all the questions in the .docx answer sheet
- Compress all the above files to one single .zip file
- Upload the .zip file **by 15:30** on the lab day
- Marks will be deducted for late submission, deduct 10 marks per every 10-minute interval (e.g. deduct 20 marks for 11 minutes late).

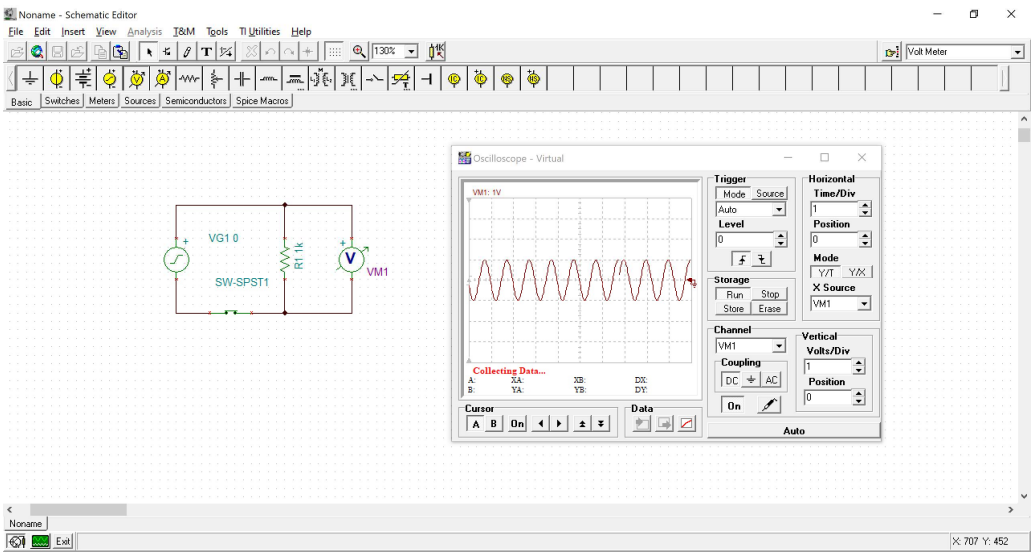
1. Installation of TINA

a. TINA is used as the simulation tools for this lab.

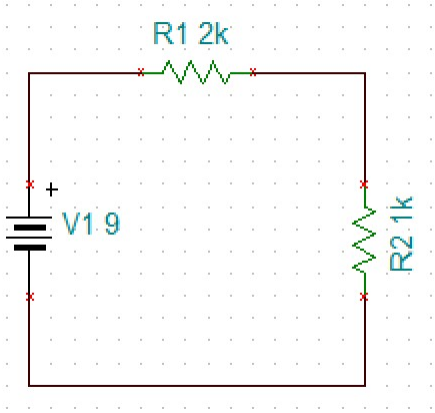
b. To install TINA, you can download TINA at Blackboard > Course Content > Lab, and install it on your Windows PC.

c. If you are using MacBook, you are required to install TINA in Windows Virtual Machine. You may download Windows Virtual Machine at https://developer.microsoft.com/zh-tw/windows/downloads/virtual-machines/

d. After installation, you should be able to execute TINA, and see something like the following.



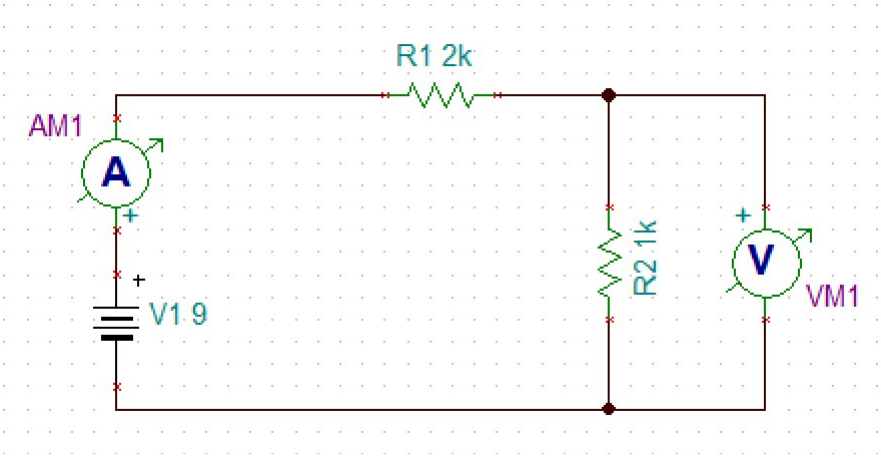
e. Draw and **Save** the following circuit as your first circuit in TINA. You can find the components at the top menu bar. For example, both Battery and Resistor are included in the Basic tab.



f. Double click the component to change their parameters as:
- Battery: Voltage = 9V
- R1: Resistance = 2k
- R2: Resistance = 1k

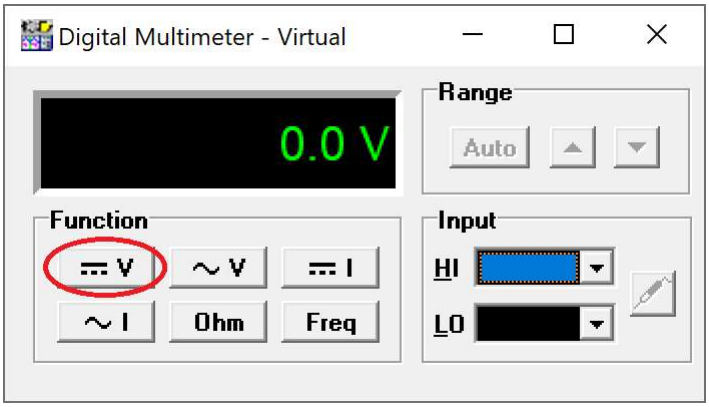
2. Multimeter

a. To measure the voltage and current of some points in the circuit, modify the circuit by adding voltmeter and ammeter as shown below. Make sure the **polarities** of both meters are correctly placed.

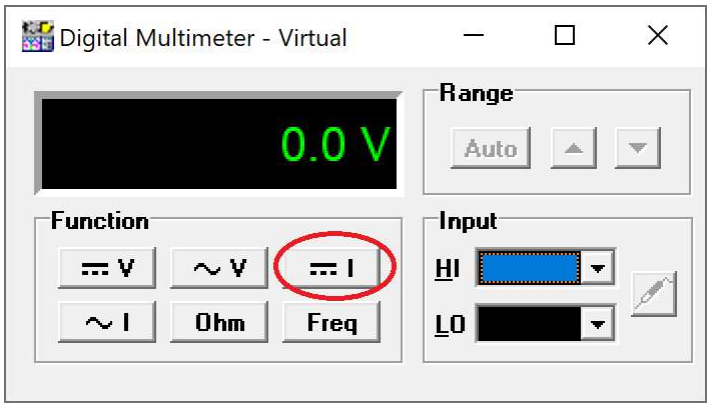


b. To launch the multimeter, from the top menu, click T&M > Multimeter.

c. To measure the voltage across R2 1k resistor, VM1, press the D.C. Voltage button on the multimeter. **Write down the value on the answer sheet.**

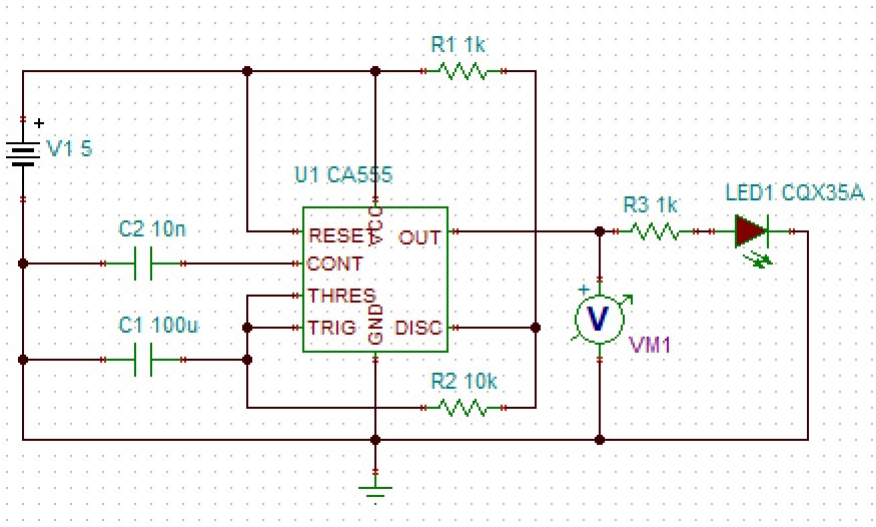


d. To measure the current of the circuit, AM1, press the D.C. Current button on the multimeter. **Write down the value on the answer sheet.**



3. Build a Timer Circuit

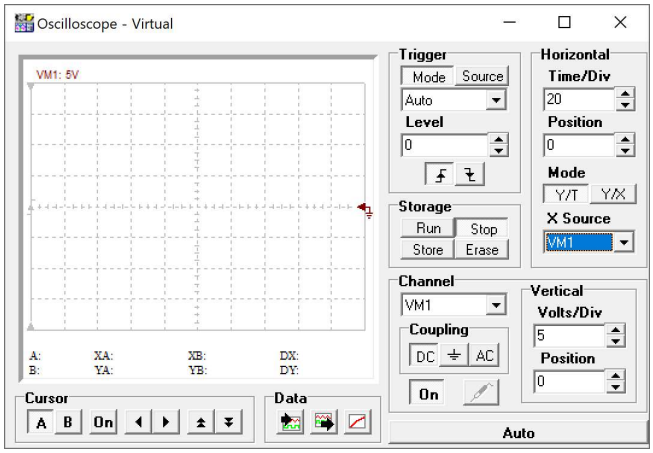
a. As shown below, there is a 555 Timer Astable Circuit which generates a periodic clock pulse at the output. The period and duty cycle of the pulse chain can be adjusted by different values of resistors and capacitors.



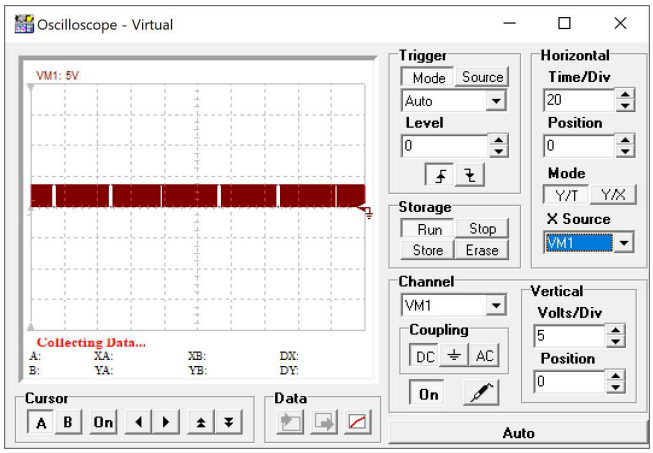
b. Draw the 555 Timer Astable Circuit in TINA. The 555 Timer component can be found at the **Semiconductors** tag. Make sure the values of all the resistors, capacitors, and battery are matched above. In reality, the output clock pulse will drive the LED1 to flash in a particular frequency. Instead, we can monitor the output clock pulse by measuring the output voltage, VM1. **Save the circuit and submit the .TSC file.**

4. Oscilloscope

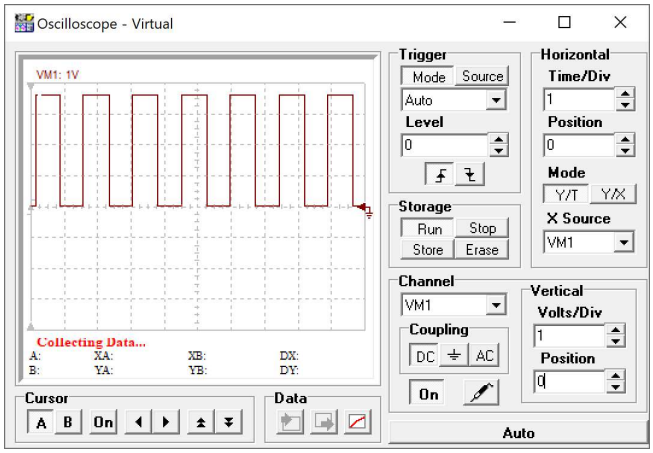
a. To verify the signals in the circuit, we can check and visualize them by using oscilloscope. To launch the oscilloscope, click **T&M > Oscilloscope** at the top menu. Check all the settings as shown below.



b. To examine the output clock pulse, press **Storage: Run** button. The clock pulse will be displayed as below.

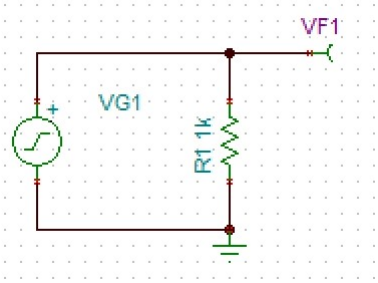


c. You can change both horizontal and vertical settings to have a better view of the signal. Change the **Horizontal: Time/Div** from 20 to 1, and change the **Vertical: Volts/Div** from 5 to 1. **Capture your Oscilloscope Windows to the answer sheet.**

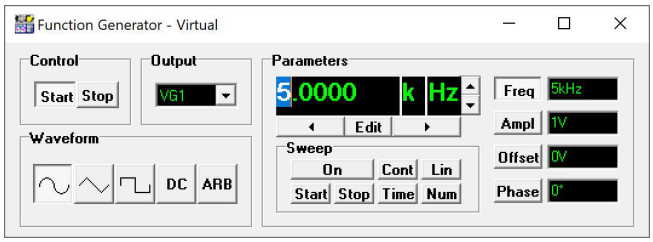


5. Signal Generator

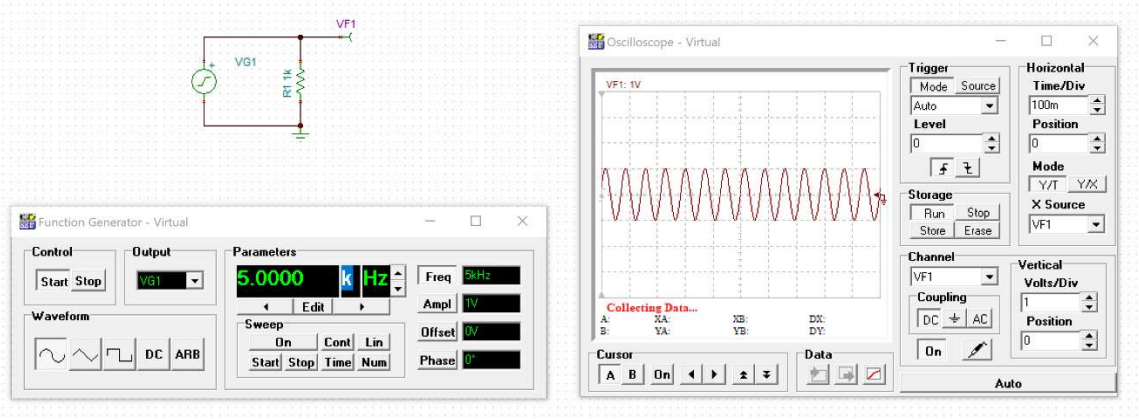
a. Draw the following circuit which consists of a Resistor R1, a Voltage Generator VG1, and a Voltage Pin VF1 as shown below.



b. Select **T&M: Function Generator** from the top menu, a function/signal generator will pop up as shown below. The output of the function generator is specified as VG1 automatically. This means that we can change the signal parameters of VG1 by changing the settings at the function generator.



c. In order to visualize the changes of VG1, we can use oscilloscope to monitor the Voltage Pin VF1 by selecting **T&M: Oscilloscope**, press **Storage: Run**.



d. Change VG1 according to the following settings, and **capture the entire TINA window which can clearly see the circuit, the function generator, and the oscilloscope for submission**.

Function Generator for VG1:

i. Triangular wave
ii. Frequency at 50 Hz
iii. Amplitude at 5V
iv. Offset at 0V

Oscilloscope for VF1:

v. DC Coupling
vi. Horizontal: Time/Div is 10ms.
vii. Vertical: Volt/Div is 2V

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Answer Sheet

Student Name:_____ SID:_____

1. Installation of TINA

2. Multimeter **[30%]**

a. Draw the circuit with voltmeter and ammeter as .TSC file, and upload it as part of your submission. [10%]

b. Voltage Measurement
VM1: _____ [10%]

c. Current Measurement
AM1: _____ [10%]

3. Build a Timer Circuit **[25%]**

a. Draw the 555 astable timer circuit as .TSC file, and upload it as part of your submission.

4. Oscilloscope **[25%]**

a. Capture your Oscilloscope window below:

5. Signal Generator **[20%]**

a. Capture your TINA window below:

THE END