HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF TELECOMMUNICATIONS ENGINEERING

FINAL PROJECT

Topic:

SINE/PULSE WAVE GENERATOR

Students: **TRẦN MINH TRÍ_2051022**
HÀ GIA HUY_2051117
LÊ TUẤN AN_2051079
BÙI THANH TÙNG_2051213
Class: **EE3411_TT01 group**
Semester: **SEM 222**
Instructor: **Dr. TRỊNH XUÂN DŨNG**

Ho Chi Minh City – 2023

OUTLINE

1. Introduction 3

2. Theory and Schematic 3

2.1 Theory 3
2.2 Schematic 9

3. Simulation and Performance Evaluation 10

3.1 Proteus 10
3.2 NI Multisim 11
3.3 Performance Evaluation 12

4. PCB Fabrication and Performance Validation 12

4.1 Top Layer - 2D view 12
4.2 Bottom Layer - 2D view 12
4.3 Front - 3D view 13
4.4 Behind - 3D view 13
4.5 Other angles - 3D view 14
4.6 Performance 15

5. References 16

1. Introduction

Topics: Sine/Pulse wave generator

Requirement: design an audio signal generator that produces a sinusoidal output with a variable frequency and amplitude and operates from dc voltages.

2. Theory and Schematic

2.1 Theory

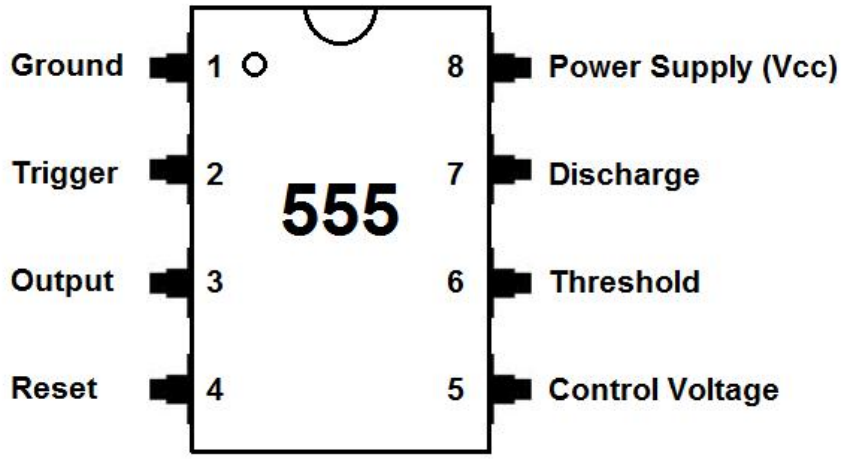
In this project, we will show how to build a wave generator circuit that allows for adjustable frequency and amplitude of the output wave signal. This square wave generator circuit can be built simply a 555 timer chip and a few resistors, capacitors, and potentiometer. The circuit is very basic. It simply uses one chip, a 555 timer. A 555 timer is a very versatile chip. It can easily create square waves when in astable mode of operation. This circuit utilizes that principle, that 555 timers can easily generate wave signals. The potentiometer allow us to vary the frequency of the output signal as well as the amplitude. This circuit can function well simply if you need waves.

So below we'll explain in detail how to build this circuit as well as how it operates.

Components Needed: 555 Timer Chip, 10kΩ potentiometer, 1nF capacitor, 1kΩ and 10kΩ resistor.

- *The 555 timer:*

We will go over the pinout of the 555 timer that can be obtained very cheaply from pretty much any electronic retailer. The 555 timer is an 8-pin chip. The pinout of the 555 timer is shown below.



Each of pins have different functions for the IC:

+ Pin 1 connects the 555 timer chip to ground.

+ Pin 2 is the trigger pin. It works like a starter pistol to start the 555 timer running. The trigger is an active low trigger, which means that the timer starts when voltage on pin 2 drops to below 1/3 of the supply voltage. When the 555 is triggered via pin 2, the ouptut on pin 3 goes high.

+ Pin 3 is the output pin. 555 timer's output is digital in nature. It is either high or low. The output is either low, which is very close to 0V, or high, which is close to the supply voltage that's placed on pin 8. The output pin is where you would connect the load that you want the 555 timer to power. This may be an LED, for instance.

+ Pin 4 is the reset pin. This pin can be used to restart the 555 timer's timing operation. This is an active low input, just like the trigger input. Thus, pin 4 must be connected to the supply voltage of the 555 timer to operate. If it is momentarily grounded, the 555 timer's operation is interrupted and won't start again until it's triggered again via pin 2.

+ Pin 5 is the control pin. In most 555 timer circuits, this pin is simply connected to ground, usually through a small capacitor, about 0.01 μF capacitor. This capacitor serves to level out any fluctuations in the power supply voltage that might affect the operation of the timer. Some circuits (though rare) do use a resistor between the control pin and Vcc to apply a small voltage to pin 5. This voltage alters the threshold voltage, which in turn changes the timing interval. Most circuits do not use this capability

+ Pin 6 is the threshold pin. The purpose of this pin is to monitor the voltage across the capacitor that's discharged by pin 7. When this voltage

reaches 2/3 of the supply voltage (VCC), the timing cycle ends, and the output on pin 3 goes low.

+ Pin 7 is the discharge pin. This pin is used to discharge an external capacitor that works in conjunction with a resistor to control the timing interval. In most circuits, pin 7 is connected to the supply voltage through a resistor and to ground through a capacitor.

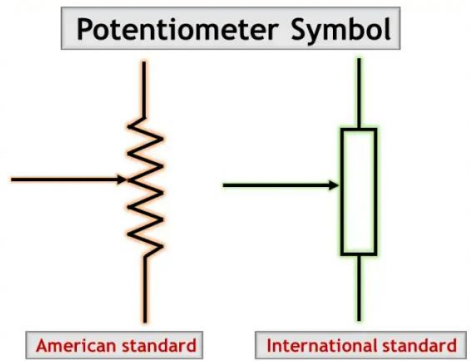
+ Pin 8 is connected to the positive power supply voltage. 555 timer ICs need DC voltage in order to operate. This is the pin which connects to the DC voltage to power the 555 chip. The voltage must be at least 4.5V and no greater than 15V. It's common to run 555 timer circuits using 4 AA or AAA batteries for 6V or a single 9V battery.

Connecting the pins in different ways, we can put the 555 timer in astable mode, bistable mode, or monostable mode. The 555 timer can be used for basic timing functions, create warning lights that flash on and off, produce musical notes of varying frequencies, and even control the control position of a servo motor.

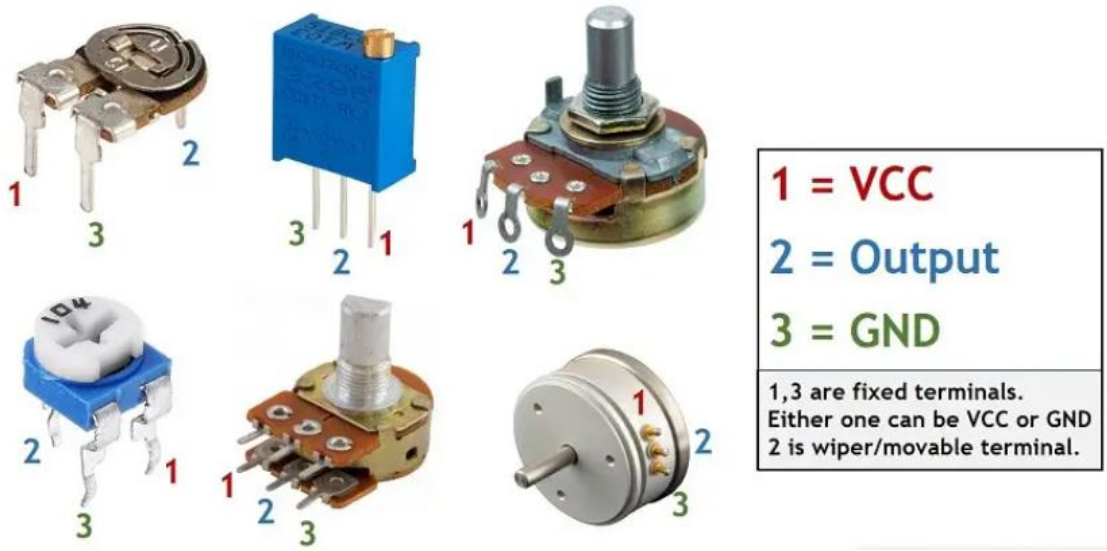
❖ *10kΩ potentiometer:*

Potentiometer is a three-leg device with a sliding or rotating contact used to create variable resistance or voltage. The potentiometer symbol comprises a resistor symbol with an arrow in the middle. Whereas its pinout may vary depending on the potentiometer type you have(linear, rotary, or digital).

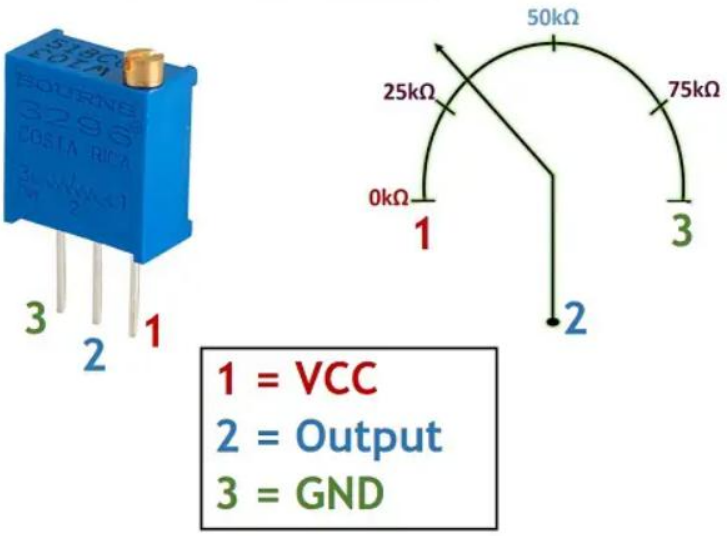
There are two ways to represent a potentiometer using symbols i.e, American Standard and International Standard. Though the International Standard potentiometer symbol is new, the American Standard one is still used in many books.



Potentiometer Pinout Diagram: the pinout of the potentiometer varies according to the type of potentiometer like sliding, rotating, or trim.



These pots are fixed in the circuit to make adjustments in the supply voltage. The resistive track in these pots is made of cement or carbon composition. The rotary wiper adjustments can be done with a small-bladed screwdriver. And this is potentiometer which we use in this project.



Potentiometer Pin Configuration:

No.	Pin Name	Description
1	Fixed End	This is connected to one end of the resistive track
2	Variable End	This is connected to the wiper, to provide variable voltage
3	Fixed End	This is connected to another end of the resistive track

Features:

+ Type: Rotary a.k.a Radio POT

+ Available in different resistance values like 500Ω, 1K, 2K, 5K, 10K, 22K, 47K, 50K, 100K, 220K, 470K, 500K, 1 M.

+ Power Rating: 0.3W+ Maximum Input Voltage: 200Vdc

+ Rotational Life: 2000K cycles

Note: Complete Technical Details can be found in the Potentiometer data-sheet given at the end of this page.

Selecting a Potentiometer:

+ Potentiometers also known as POT, are nothing but variable resistors. They can provide a variable resistance by simply varying the knob on top of its head. It can be classified based on two main parameters. One is their Resistance (R-ohms) itself and the other is its Power (P-Watts) rating.

+ The value or resistance decides how much opposition it provides to the flow of current. The greater the resistor value the smaller the current will flow. Some standard values for a potentiometer are 500Ω, 1K, 2K, 5K, 10K, 22K, 47K, 50K, 100K, 220K, 470K, 500K, 1 M.

+ Resistors are also classified based on how much current it can allow; this is called Power (wattage) rating. The higher the power rating the bigger the resistor gets and it can also more current. For potentiometers the power rating is 0.3W and hence can be used only for low current circuits.

Applications: voltage and current control circuits, used as volume control knobs in radios, tuning or controlling circuits, analog input control knobs

❖ *Capacitor:*

A capacitor is a device that stores electrical energy in an electric field by virtue of accumulating electric charges on two close surfaces insulated from each other. It is a passive electronic component with two terminals.

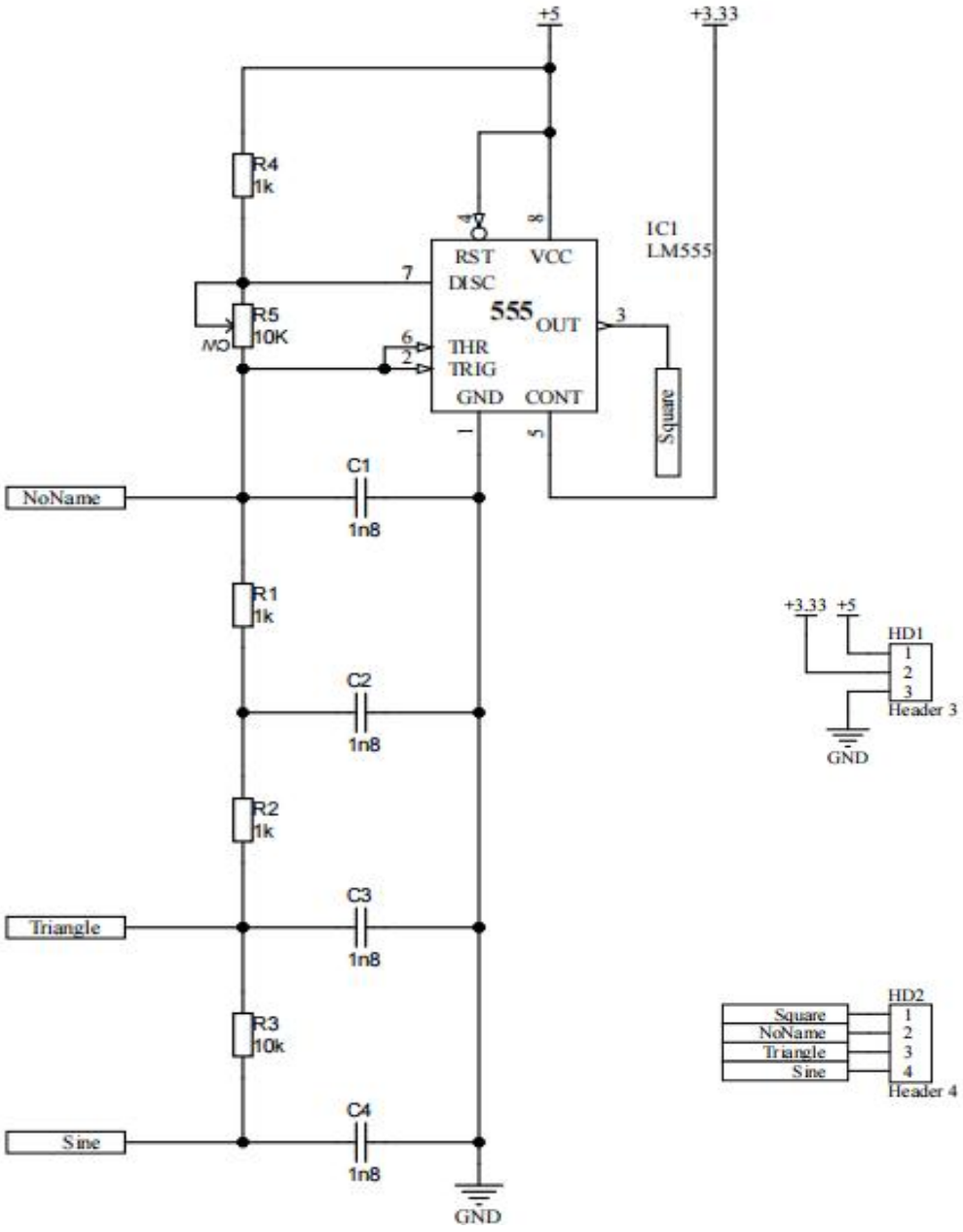
In this project, we use 1nF capacitor, SMD, Ceramic, 1nF, 10%, 50V, X7R 0805 with 10% error.

❖ *Resistor:*

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.

In this project, we use 1kΩ and 10kΩ resistor, SMD, 0.125W, 0805 with 5% error.

2.2 Schematic



3. Simulation and Performance Evaluation

3.1 Proteus

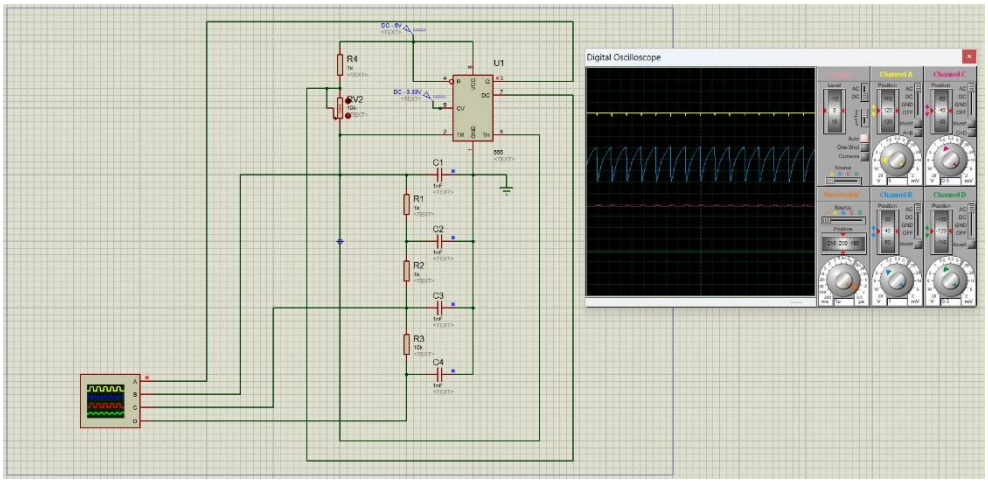


Figure 3.1a: 10kΩ potentiometer (100%)

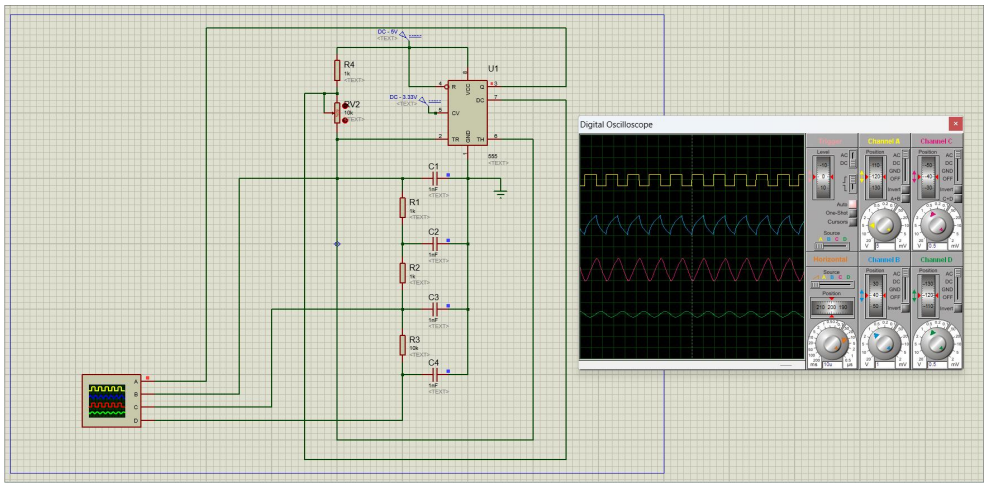


Figure 3.1b: 10kΩ potentiometer (50%)

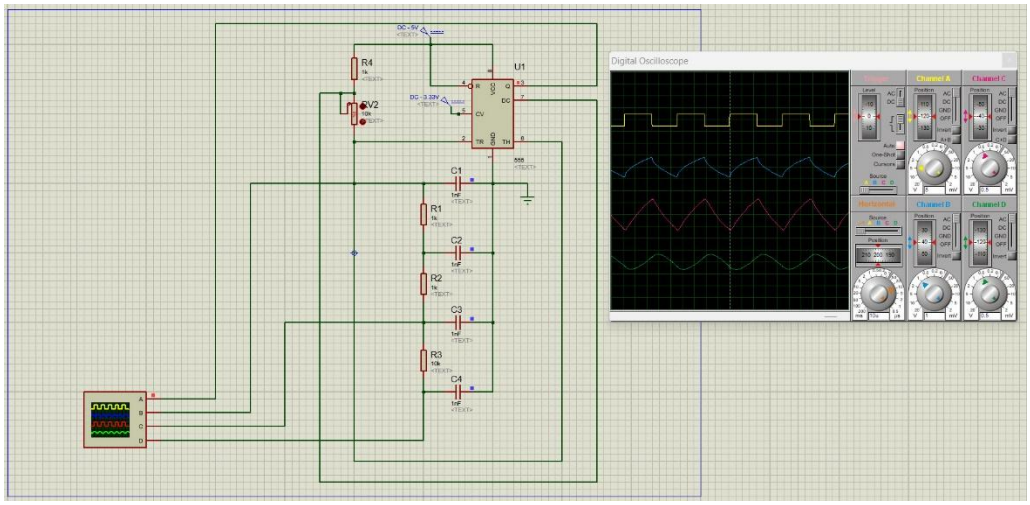


Figure 3.1c: 10kΩ potentiometer (0%)

3.2 NI Multisim

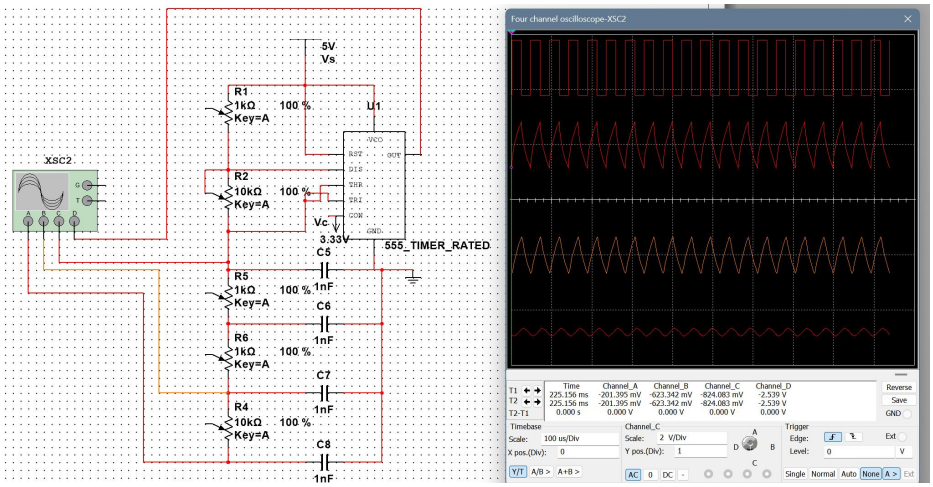


Figure 3.3a: 10kΩ potentiometer (100%)

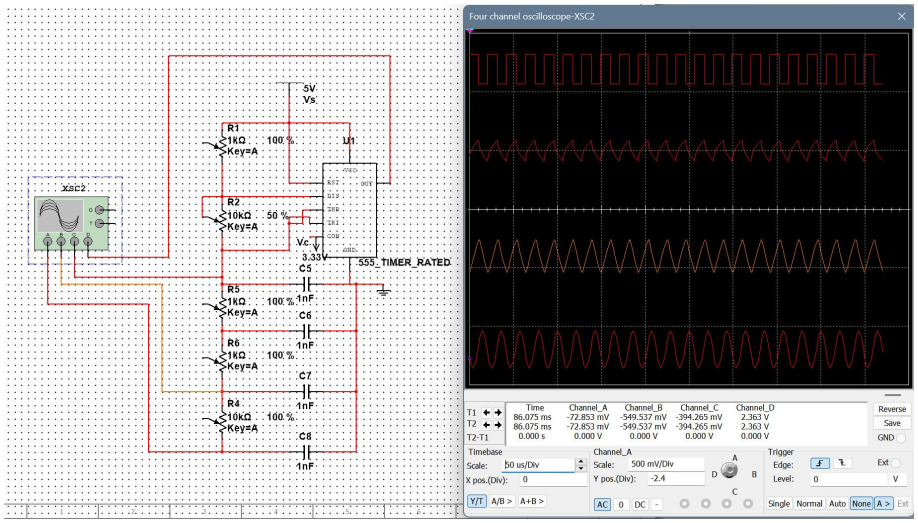


Figure 3.3b: 10kΩ potentiometer (50%)

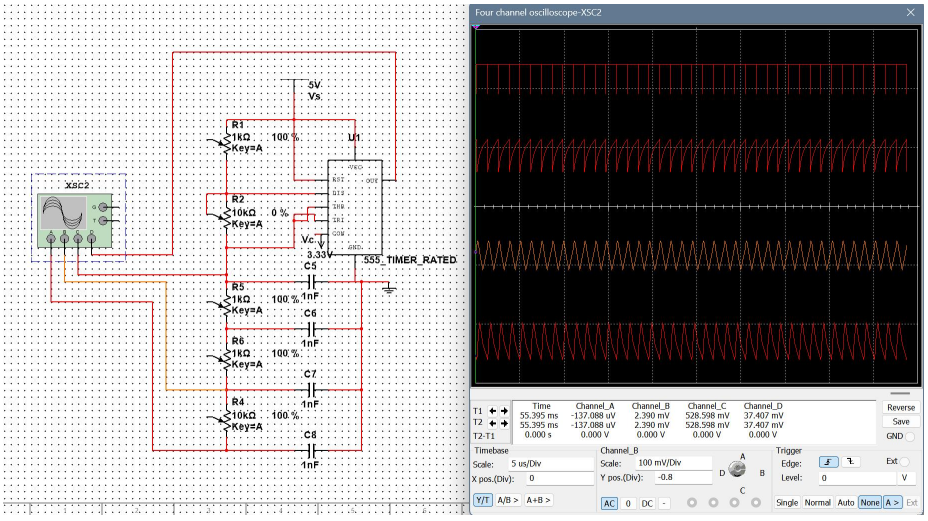


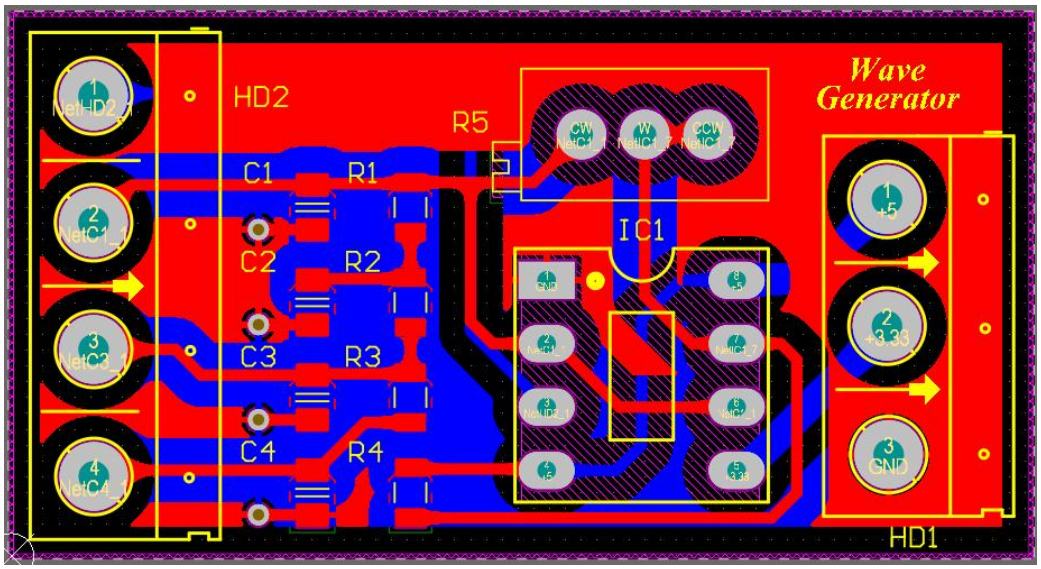
Figure 3.3c: 10kΩ potentiometer (0%)

3.3 Performance Evaluation

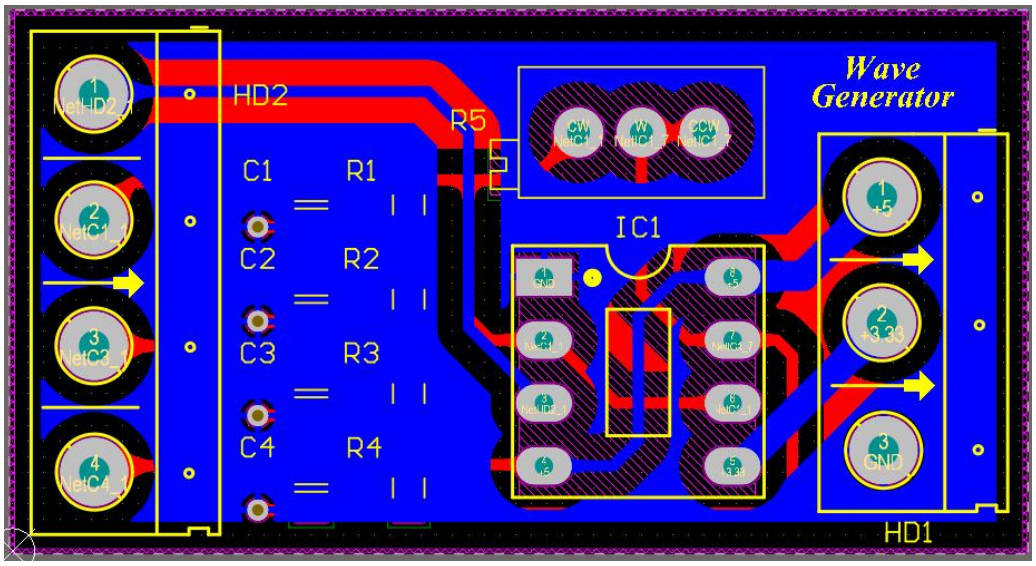
The OUT pin of 555 Timer Chip generate square wave. The wave, which we call “no name” wave with shape nearly like sine wave, is generated by combination of THR and TRIG pin of 555 Timer Chip. This signal of this wave convert to triangle wave after passing two 1kOhm resisters and filtering by two 1nF capacitors. Finally, it convert to sine wave after passing 10kOhm resister and filtering continuously by 1nF capacitor, however the amplitude at this point reduce 10 times due to 10kOhm register.

4. PCB Fabrication and Performance Validation

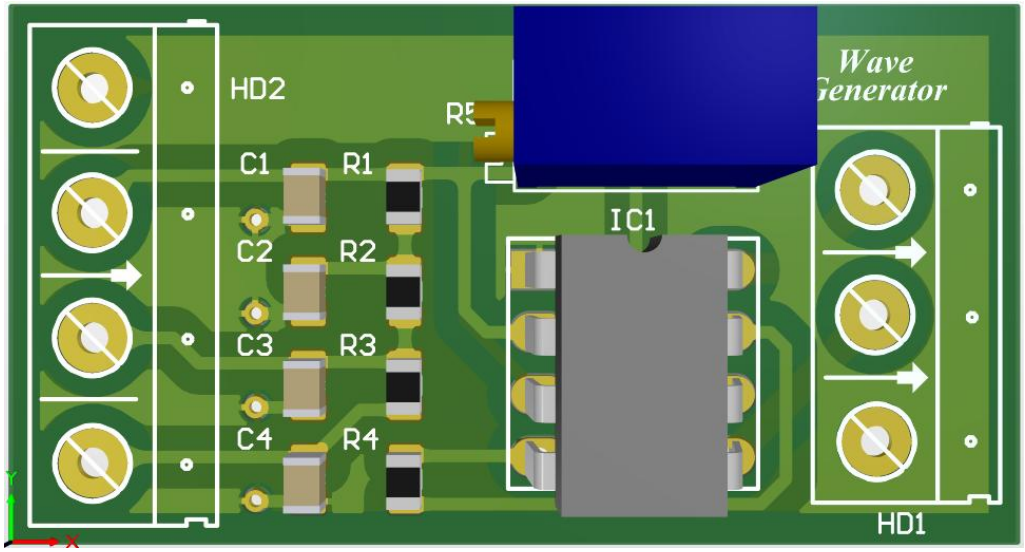
4.1 Top Layer - 2D view



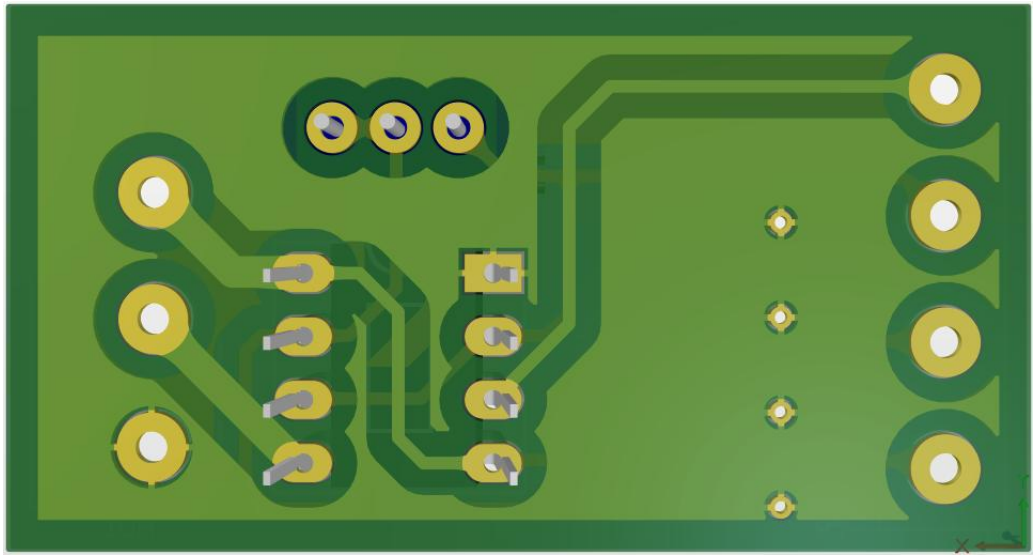
4.2 Bottom Layer - 2D view



4.3 Front - 3D view



4.4 Behind - 3D view



4.5 Other angles - 3D view

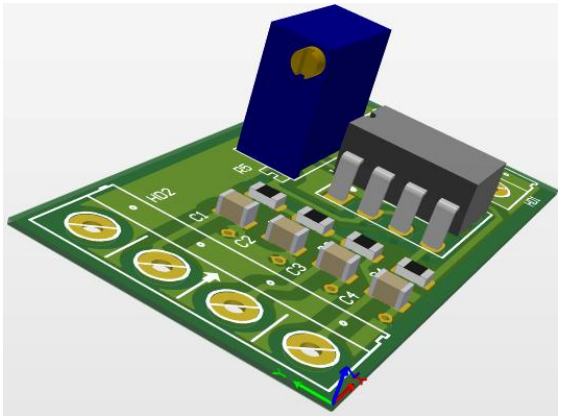


Figure 4.5a: Top – down direction

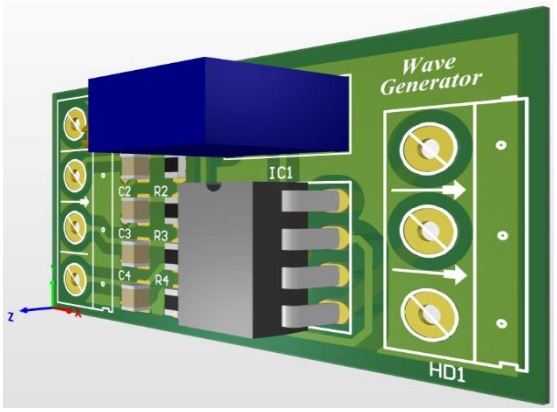


Figure 4.5b: Left – right direction

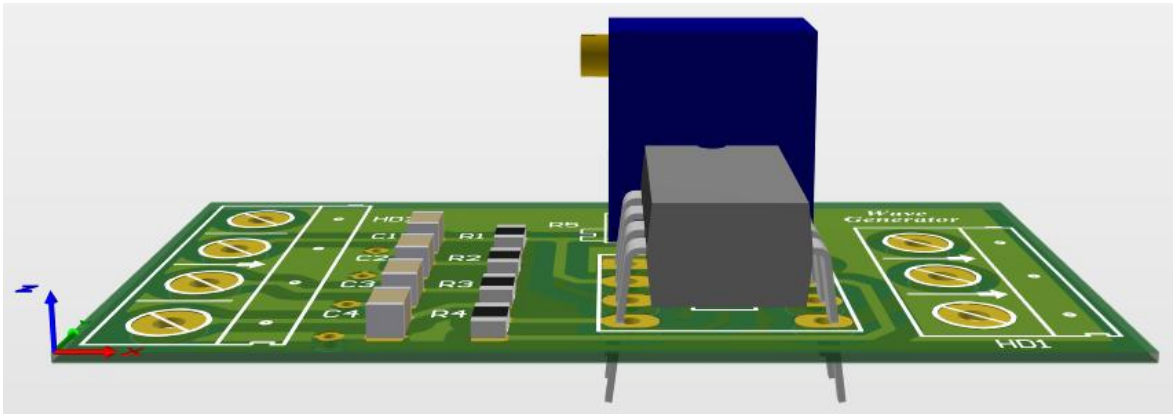
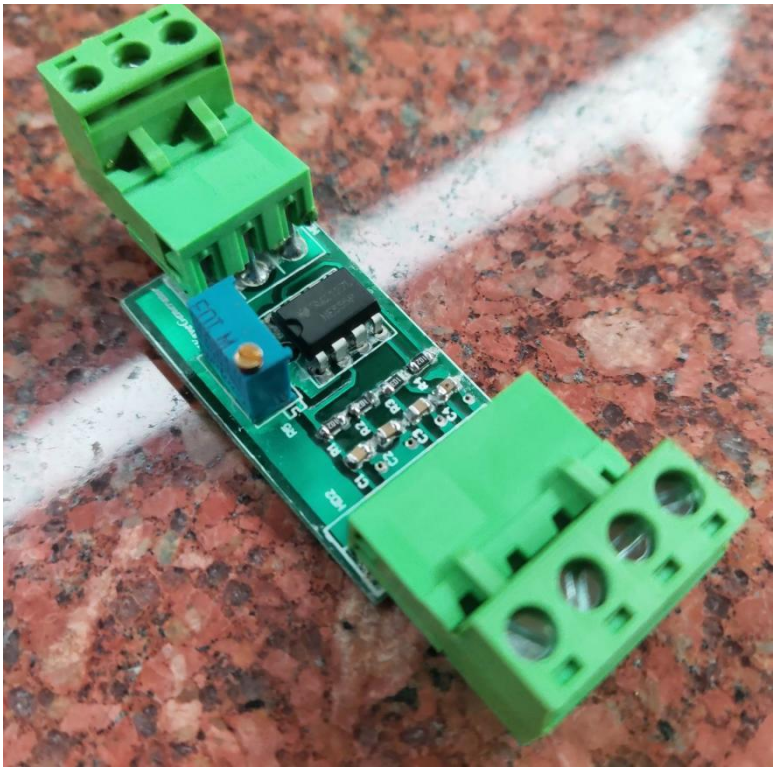


Figure 4.5c: Front – back direction

4.6 Performance



5. References

[1] “555 Timer Pinout”, Learning about Electronics,

Access from: http://www.learningaboutelectronics.com/Articles/555-timer-pinout.php

[2] “How to Build a Sine Wave Generator with a 555 Timer Chip”, Learning about Electronics,

Access from: http://www.learningaboutelectronics.com/Articles/Sine-wave-generator-circuit-with-a-555-timer.php

[3] “How to Build a Sine Wave Generator with a 555 Timer Chip”, Learning about Electronics,

Access from: http://www.learningaboutelectronics.com/Articles/Adjustable-square-wave-generator-circuit-with-a-555-timer.php

[3] “Potentiometer Symbol and Pinout Diagram(Trim, Rotary)”, eTechnophiles,

Access from: https://www.etechnophiles.com/potentiometer-symbol-pinout/

[4] “10K Potentiometer Pinout, Working & Datasheet Explained”, components101,

Access from: https://components101.com/resistors/potentiometer