

# A Function Generator

March 2024

## Abstract

This report presents the design and implementation of a versatile Function Generator capable of producing sinusoidal, square, triangular, and DC waveforms tailored to user specifications. It allows users to adjust the waveform type, amplitude, and frequency. The implementation offers flexibility and control over signal generation.

## A Brief Overview

### Main circuits

There are 3 important parts :-

- Timer controlled Counter Chip
- Switching Circuit
- Amplification and Frequency Control

### Working

- The generator generates 4 signals, namely DC, square, sine, and triangular wave.
- At the beginning, a switching circuit has been implemented to switch between the 4 signals.
  - The circuit uses a 555 timer IC, a 2-bit counter, and 1x4 DeMultiplexer.
  - The 555 timer is used in Monostable mode whose output is controlled by a push button.
  - When the button is pushed, the timer IC generates a pulse which is used to increment the counter.
  - The value of the counter is then used to control the output line of the DeMultiplexer.
- The Square wave is generated with the use of a timer in astable mode.
  - The timer IC behaves as an oscillator and generates a clock pulse.
  - The clock pulse is passed through a summing circuit such that the DC Offset is made 0V.
- Now, apart from the DC wave, all the other output signals require the square wave.

- Square Wave → Square Wave
- Square Wave → Integrator → Triangular Wave
- Square Wave → LC Oscillator → Sine Wave
- Therefore, a circuit is placed which chooses between the DC output and the square wave output.
  - \* If DC → ON implies the Square Wave generator is OFF.
  - \* If DC → OFF implies the Square Wave generator is ON.
- If the output is a DC wave it is directly taken.
- If the output is a Square Wave, then depending on whether the signal we want (square, triangular, sine), different operations are performed on the square wave.
- Which operation to perform is controlled using transistor switches.
  - Which transistor will work in saturation mode and which transistor will work in cutoff mode depends on the output of the DeMultiplexer.
- At the end, there is a 4X1 Multiplexer which chooses the required signal and feeds it into an amplifier.
- The amplified signal is displayed on the oscilloscope.
- In this circuit, we can vary the frequency and the amplitude of the wave using potentiometers.

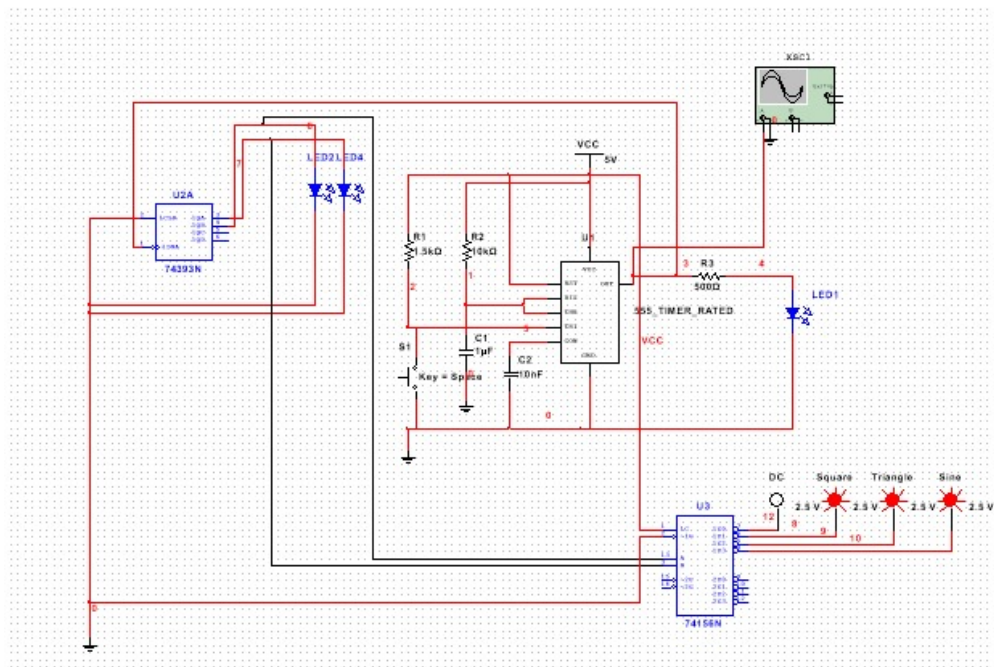


Figure 1: Switching circuit using 555 timer and counter

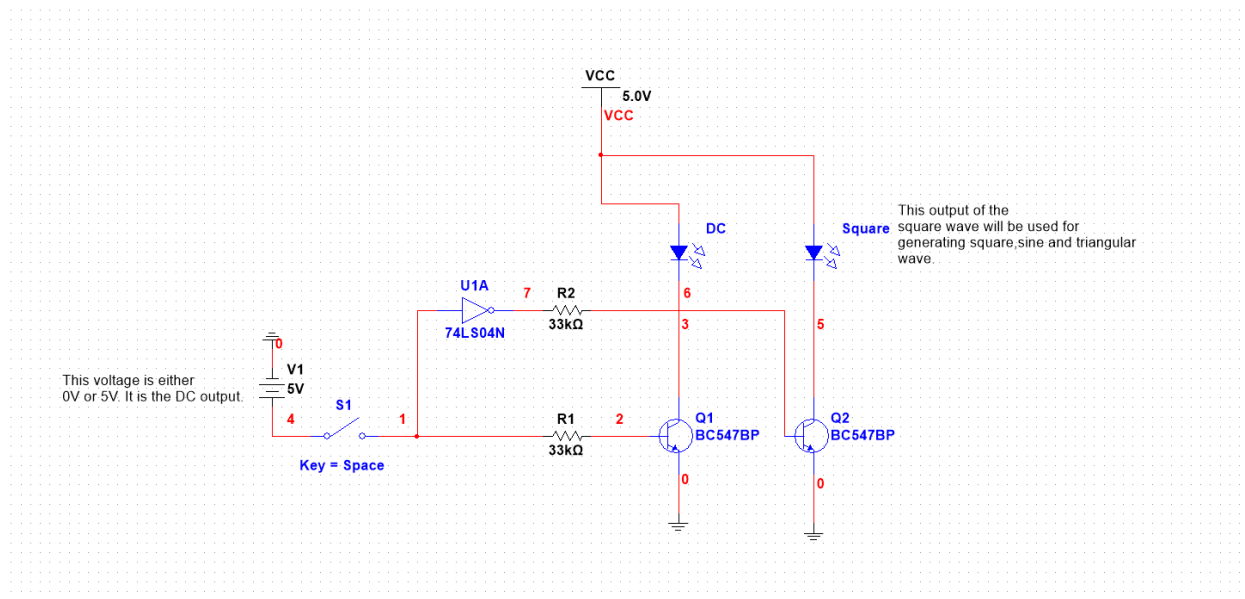


Figure 2: Circuit responsible for selecting DC input or square signal

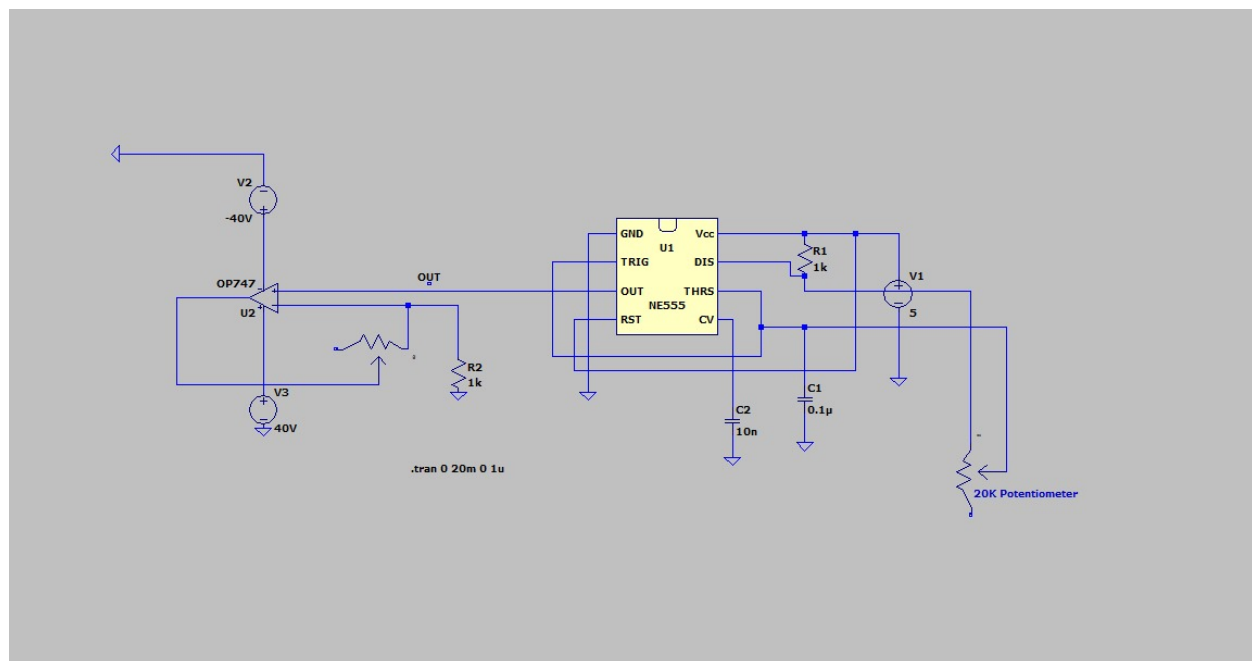


Figure 3: Circuit to control Frequency and Amplitude

## DC generation

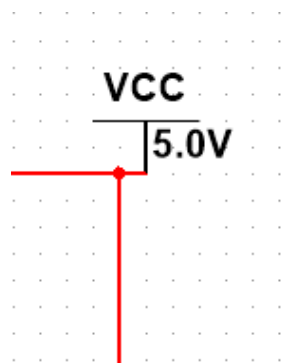


Figure 4: The produced 5V is the output

## Square wave generation

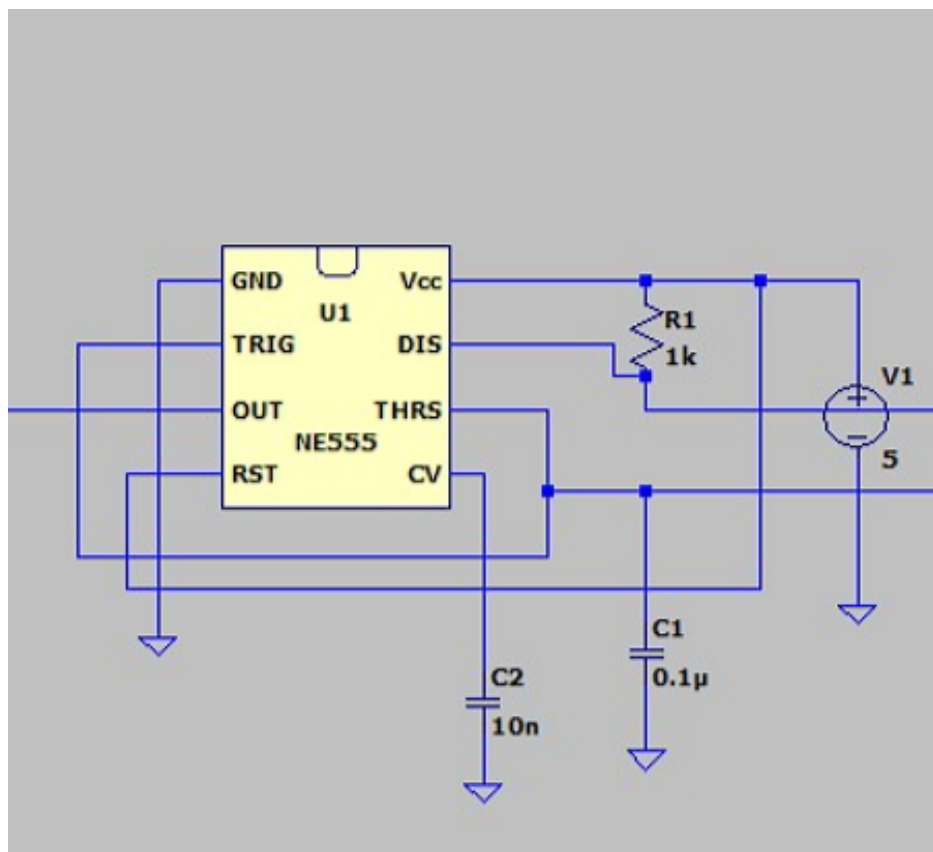


Figure 5: Timer chip generates square wave

## Sinusoidal wave generation

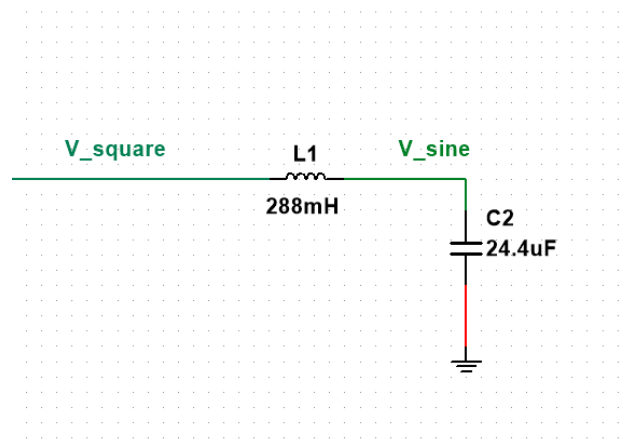


Figure 6: The square wave generated is passed through LC oscillator

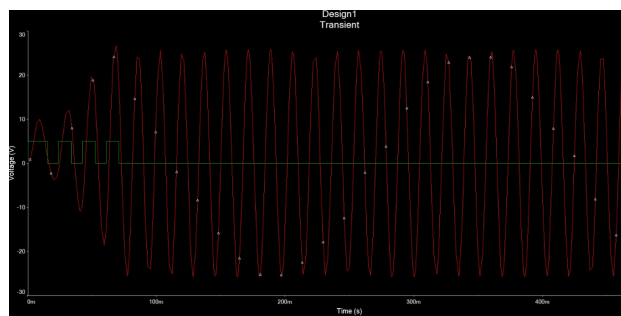


Figure 7: Sine signal generated

## Triangle wave generation

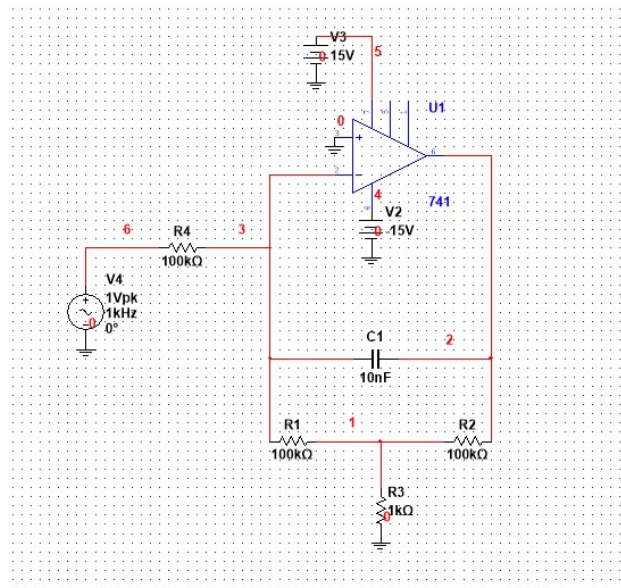


Figure 8: Square wave fed into an Active Integrator

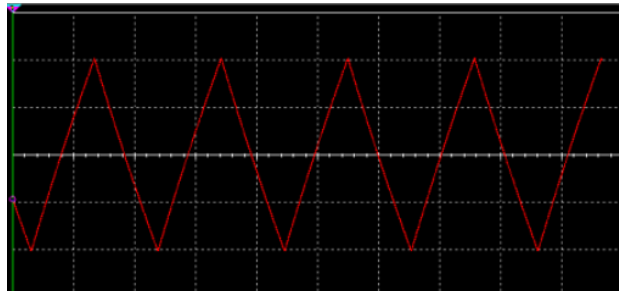


Figure 9: Generated Triangle wave

## Frequency controlling

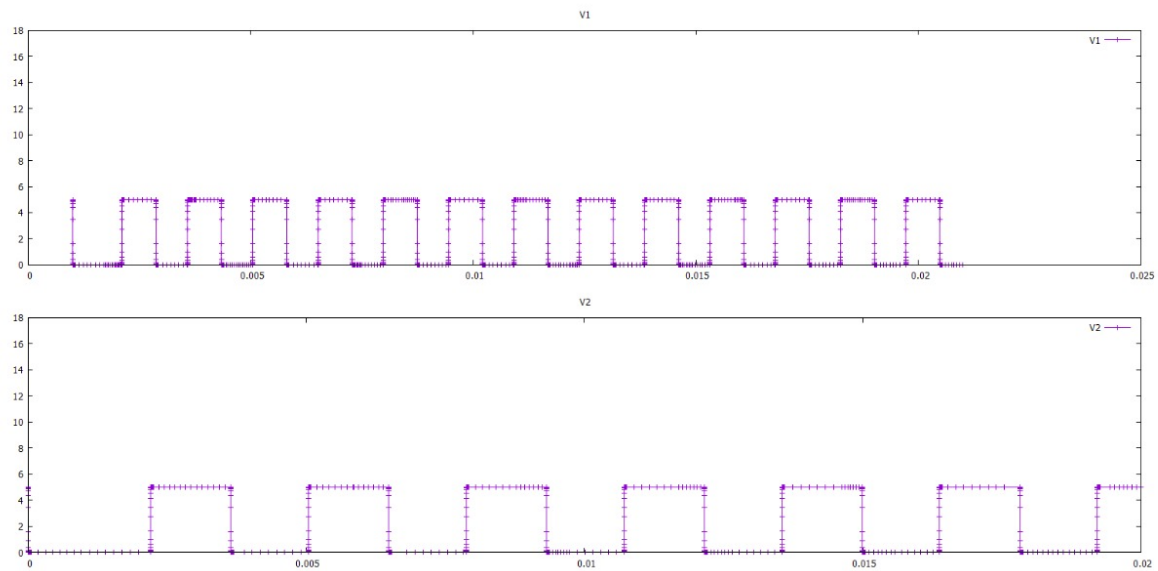


Figure 10: The generated square wave's frequency is changed

## List of Components

- Resistors
- Capacitors
- Inductor
- Potentiometer
- Transistors
- IC 741 Opamp
- Counter chip 74HC393
- Logic Gates
- Switches
- 555 Timer chip