Function Generator

Introduction

That are used to generate different types of electrical waveforms over a wide range of frequencies.

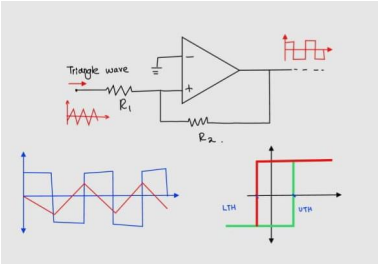
The most common waveforms produced by the function generator are the ”**Sine wave, Square wave , Triangular wave and Sawtooth wave**”. Another feature included on many function generators is the ability to add a **DC offset**.

Function generators were designed using basic analog circuits that incorporated operational amplifiers, resistors, and capacitors.

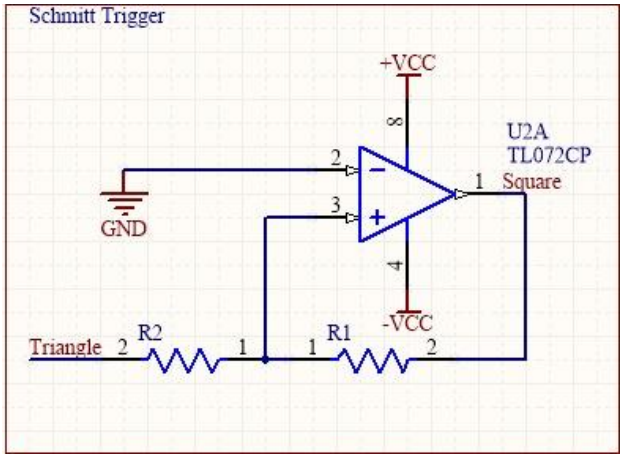
These analog function generators operated by creating waveforms through a feedback loop and subsequently filtering the output to attain the intended waveform.

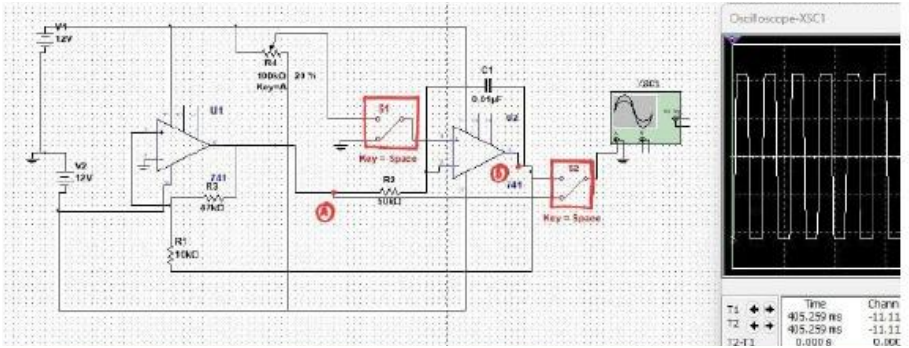
We are designing a function generator for our project using only **transistors, resistors, potentiometers, op Amps and capacitors**. In this report, the different techniques which were used to generate waveforms and change the characteristics of the wave forms will be described.

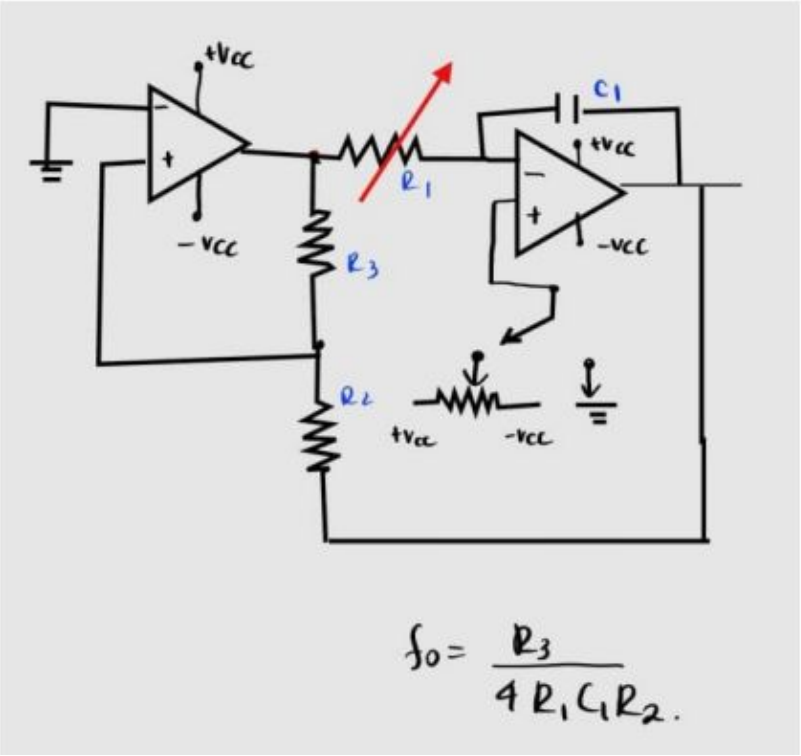
Square wave generator



- Construct square wave generator with op-amp Schmitt trigger.
- Exploit hysteresis property for square wave generation.
- Apply input triangle wave to non-inverting terminal.
- Trigger transitions at upper threshold during rising edge, switching output states.
- Falling edge crossing lower threshold reverts output, ensuring continuous square wave generation.





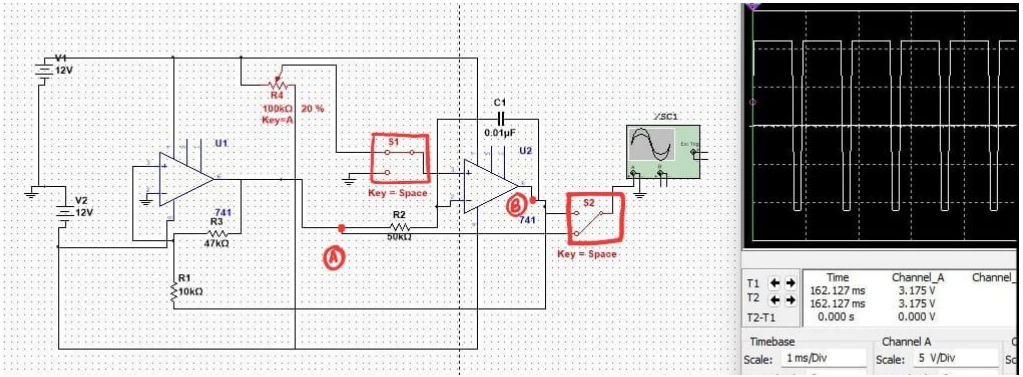


$$f_0 = \frac{R_3}{4 R_1 C_1 R_2}.$$

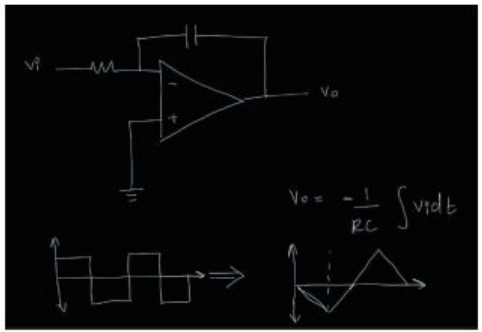
Frequency range	capacitor value
20Hz - 500Hz	1μF
500Hz - 1.2kHz	100nF
1.2kHz - 20kHz	10μF

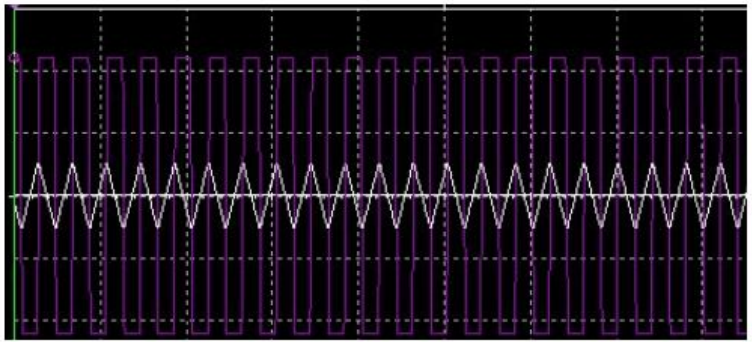
PWM generator

- The non inverting input of the second op amp is connected to a variable resistor, giving a DC voltage to the input.
- The signal is taken from position A.
- The duty cycle of the PWM signal is set by the DC voltage at the non-inverting input of the integrator.
- By changing this DC voltage, you can vary the duty cycle of the PWM waveform.
- The frequency of the PWM signal is determined by the frequency of the triangle wave.



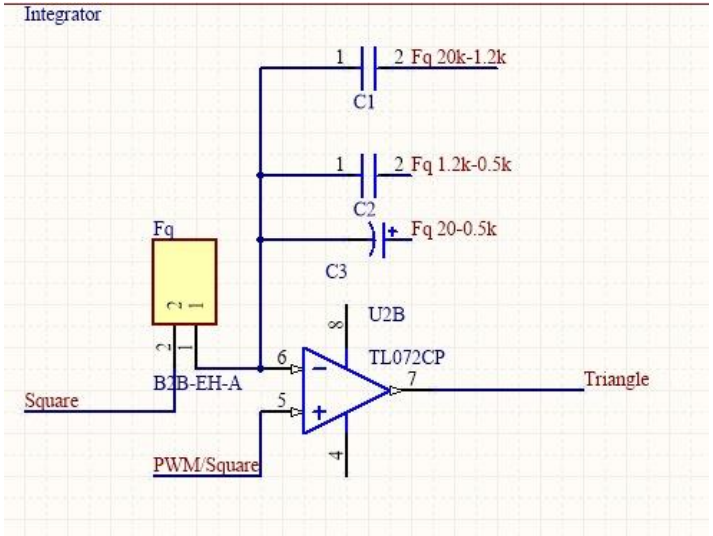
Triangle wave is generated by Integrating the square wave

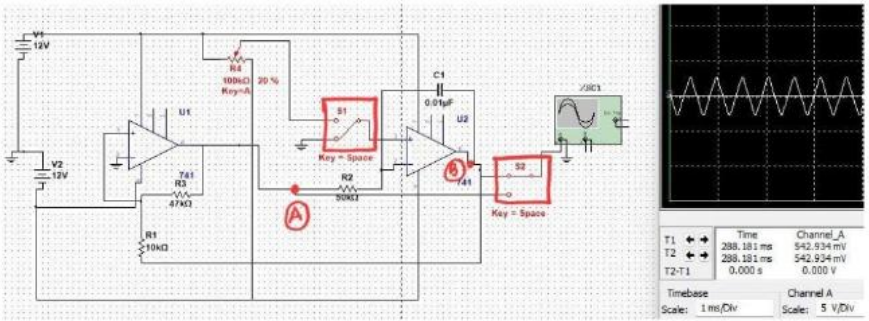




Triangle generator

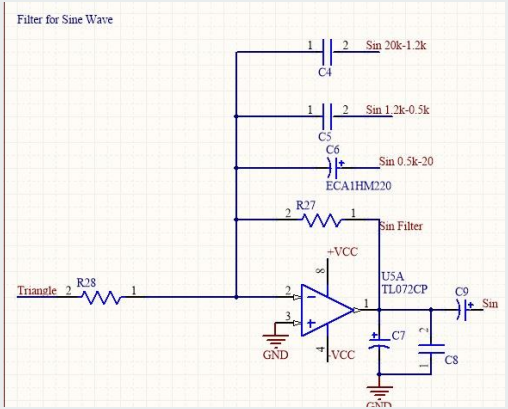
- Triangle Waves are generated by connecting integrator circuit at the output of schmitt trigger.
- This is created by integrating the square signal by the integrating circuit containing the second op amp and capacitor.
- A continuous triangle signal is generated.

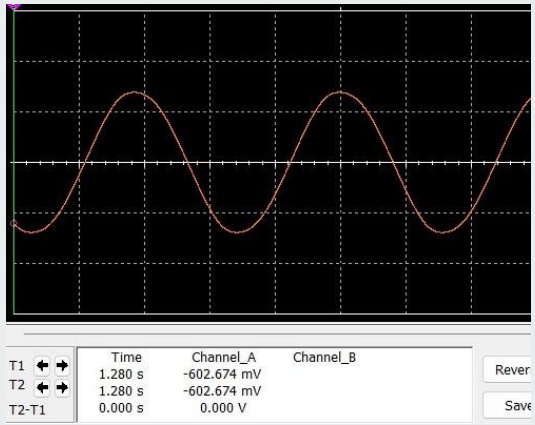




Sine wave generator

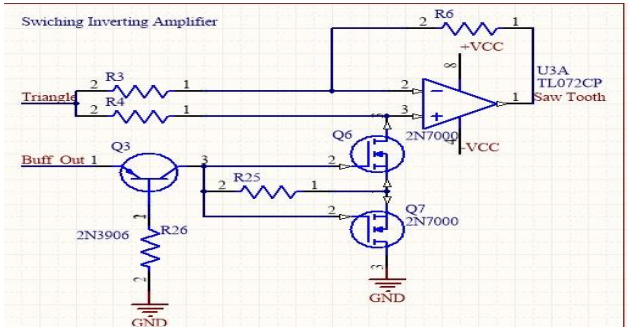
- By adding a low pass filter to triangle wave form we generated the sine wave
- C7 & C8 capacitors use to improve stability



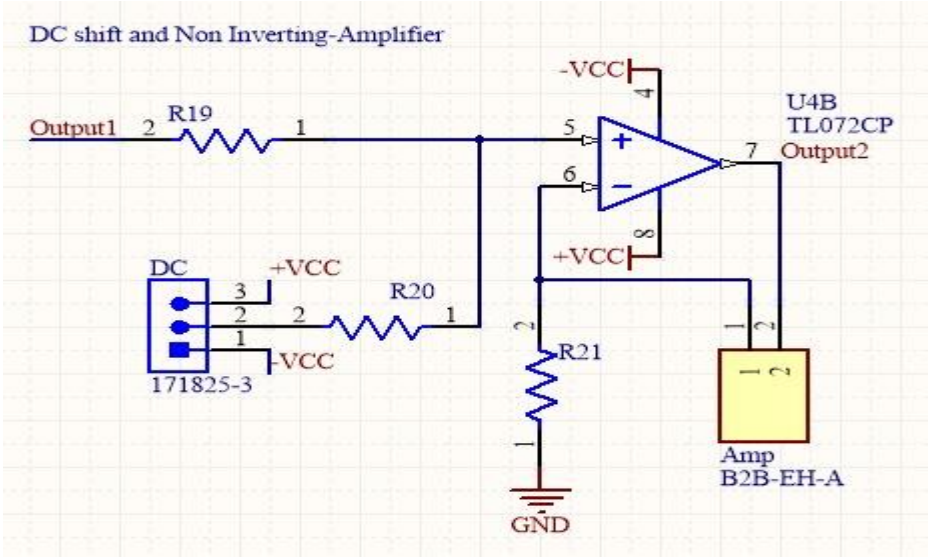


Sawtooth generator

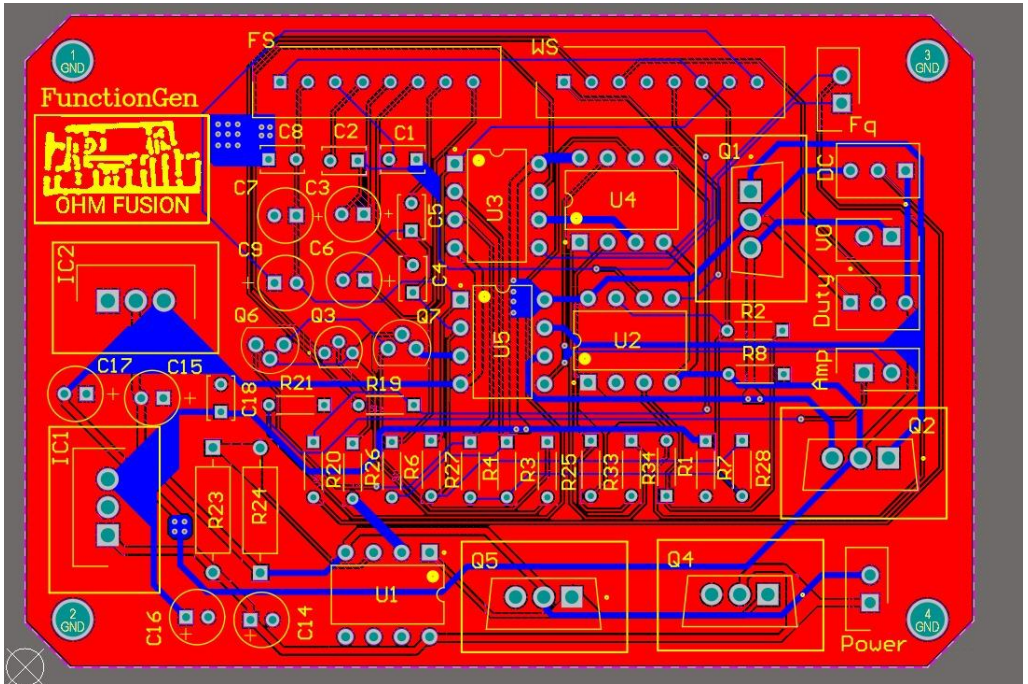
- Design a sawtooth wave generator using an op-amp as an inverting amplifier.
- Utilize a MOSFET as a switch, allowing the capacitor to charge through the MOSFET.
- Implement a feedback network to set the inverting amplifier gain.
- For a common amplifier, use a summing amplifier with DC offset to efficiently handle input signals.
- Integrate an inverting amplifier for gain reduction in shaping square wave signals before routing to the common amplifier.

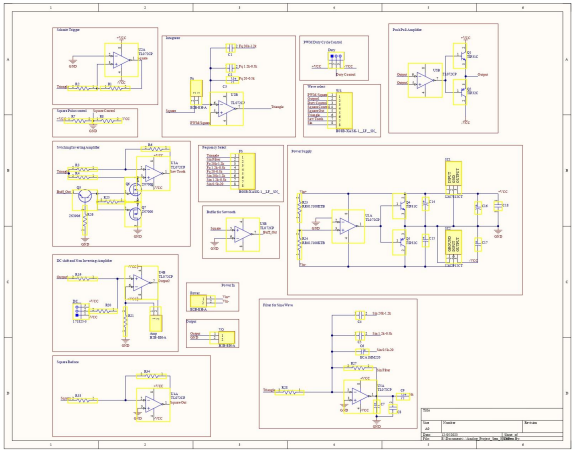


Amplification circuit with DC offset



PCB: using Altium





Enclosure: using SolidWorks