East West University

PROJECT

Course Code and Name: CSE251 **Electronic Circuit**	
Project Name: **Design of a Triangular wave generator using Operational Amplifier for a specified input.**	
Semester and Year: **Spring 2023**	**GROUP NO: 07**
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Date of Submission: **19/5/2023**	

Title: Design of a Triangular wave generator using operational amplifier for a specified input.

***Problem Statement*:** Fig.1 shows a design process of a Triangular wave generator circuit. The design process includes two design segments (a square wave generator & a triangular wave generator) to get the final output vo(V). Use a 10Vpp sinusoid as input and operational amplifiers to design. Design the circuit components and finally simulate to test the circuit. [Note that, for design purpose, the values of the resistors should not exceed more than 10kΩ.]

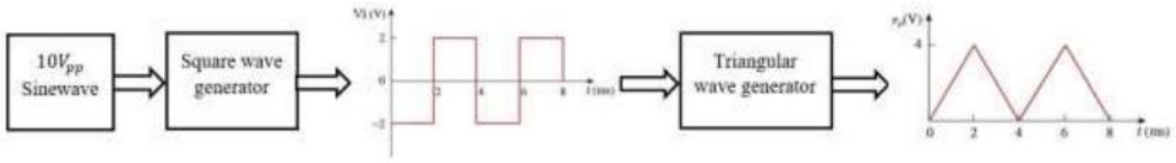


Fig. 1

Design Details:

Transient sine voltage source, also known as VSIN, is used as the input voltage to obtain the sine wave requested in the inquiry. A smooth sine wave is produced when we apply 10 V p-p, which equals 5 V amplitude and 1 KHz frequency.

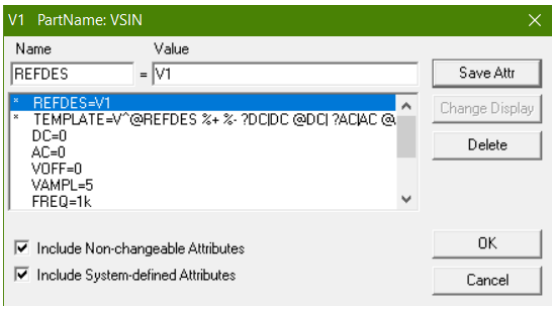


Fig-1: Values of VSIN

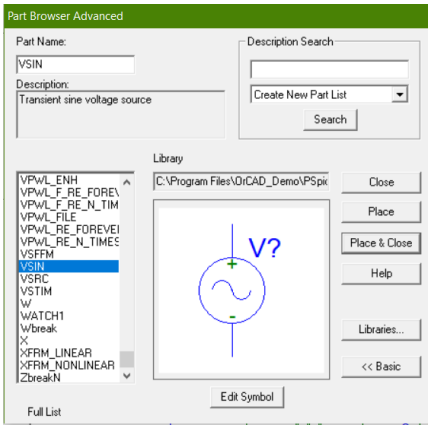
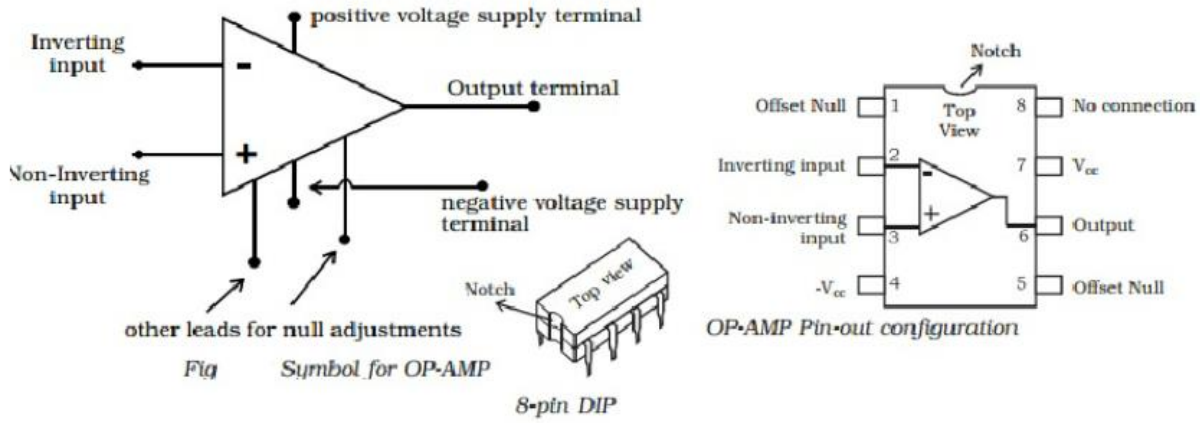


Fig-2: Voltage Source -VSIN

Abstract: Generate Triangular Waves Simply attaching an integrator to the square wave generator will create an Op amp. By alternately applying a constant current to charging and discharging a capacitor, a triangular wave is produced. Integrator connections enable this. circuit at the square wave generator's output. The triangle wave has the same frequency as the square wave. Although the square wave's amplitude is constant (Vsat), the triangular wave's amplitude falls as its frequency rises and vice versa. This is due to the fact that a capacitor's reactance increases at low frequencies and decreases at high frequencies. In this project, we've shown that an integrator with a square wave input will produce a triangular wave generator using an Op amp as the output. Thus, by simply coupling an integrator to the square wave generator, a triangular wave generator using an Op amp can be created.



Source: https://www.brainkart.com/article/Circuit-symbol-and-Pin-out-configuration-of-an-OP-AMP_3003/

Design Details: Here, we must first transform the sine wave into a square wave. Using a Schmitt trigger circuit, sine to square can be converted. Schmitt trigger circuits are essentially positive feedback comparators. For the first portion, we employed an OPAMP Schmitt trigger circuit. Upper trigger point (UTP) and lower trigger point (LTP) are the voltages in a Schmitt trigger at which the output changes from +vsat to -vsat or vice versa. Hysteresis is the term for the disparity between the two trip points.

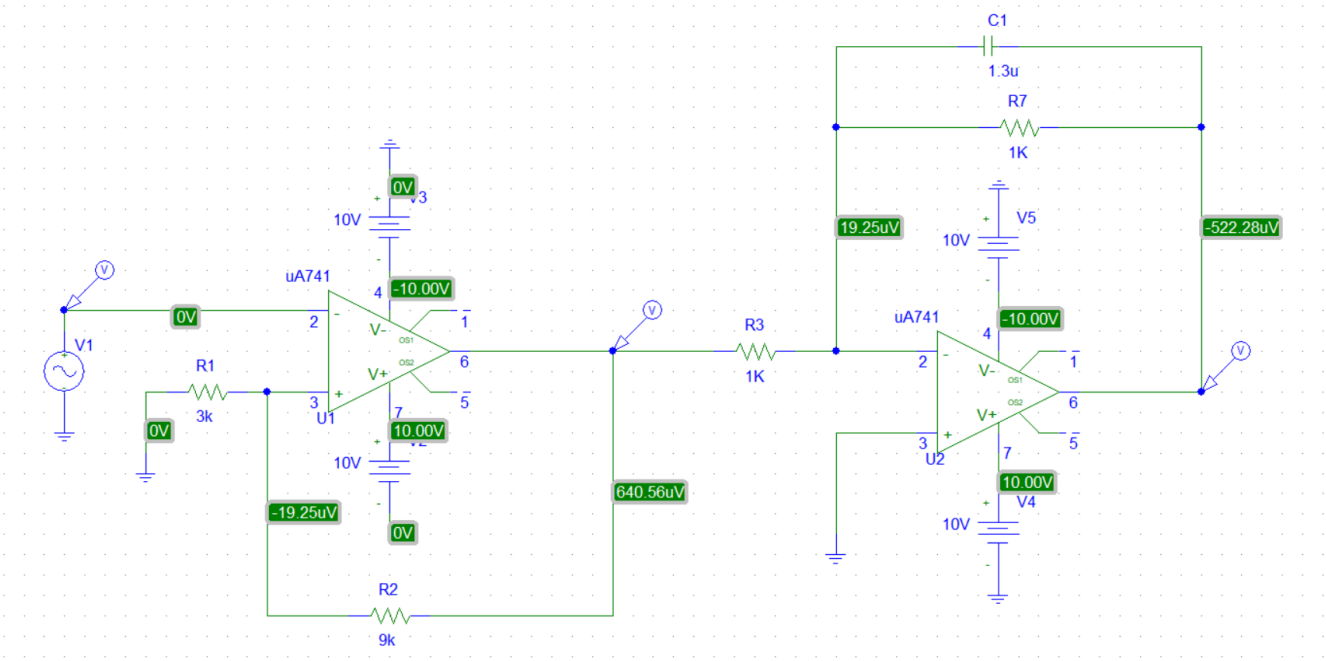
So, this is how the first segment will show us square output. Now, the output of the first segment will work as an input for the second segment. We need to build a triangular wave generator which will take square input and show us triangular output waveform.

We have implemented this using an integrator circuit. An integrator circuit produces a triangle wave as its output when a square wave as its input. Using an operational amplifier, two resistors, and a capacitor, an integrator circuit can be created. Capacitor charges to its maximum voltage and produces a linear ramp when a constant voltage is applied through a resistor. In order to transform a square wave into a triangular wave, this principle is applied. There are just two voltage levels in a square wave: +V and -V. As a result, the capacitor charges to +V during the positive cycle of the square wave, producing a positive ramp. Similar to this, a capacitor produces a negative ramp during a negative cycle by charging to -V. Thus, it consistently delivers both positive and negative results.

For the convenience of the design, we have set the values of resistors as, R1= 3K ohm, R2= 9K ohm, R3= 1K ohm, R7= 1K ohm.

The value of Capacitor is, C = 1.3uF

Circuit Diagram:

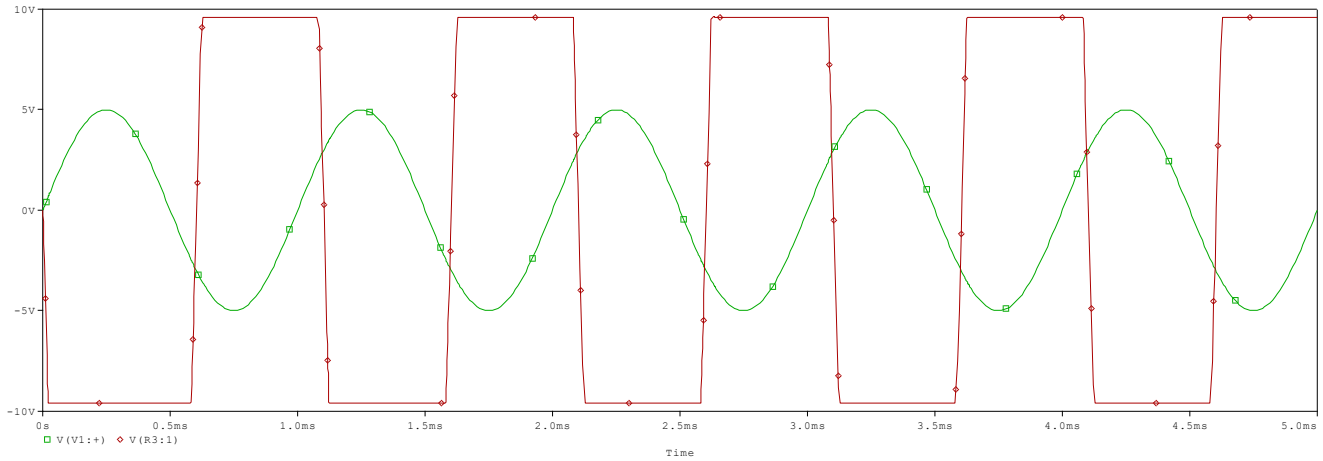


The first block is the Schmitt Trigger circuit using an op-amp which generates square output from sine wave input.

The second block is an integrator circuit, which generates triangular output from square input. Here, the output of Schmitt Trigger circuit is the input for the integrator circuit

Simulation Results: We have performed the simulation using PSpice.

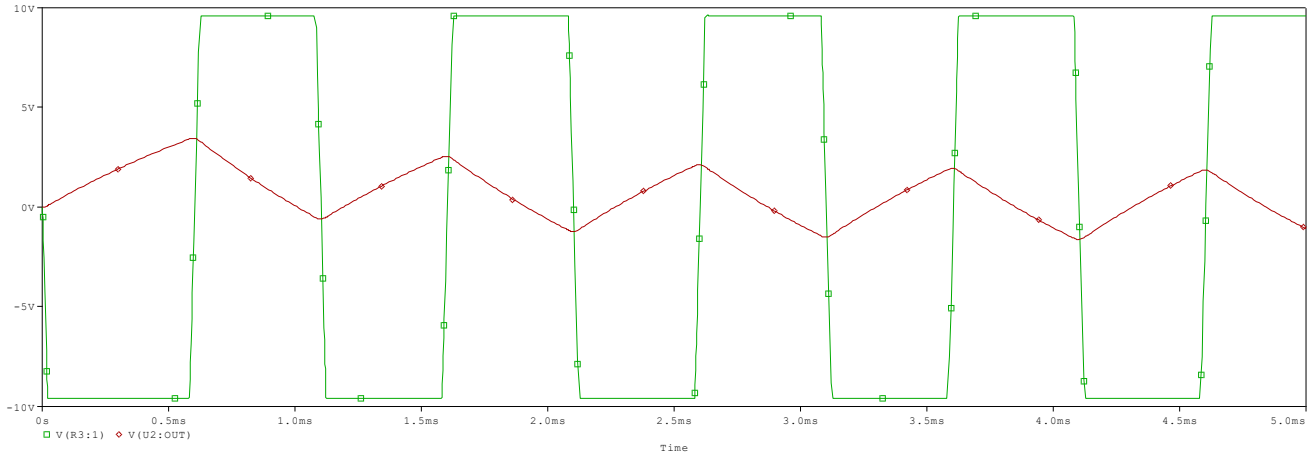
Result of the first segment:



Input: sine wave

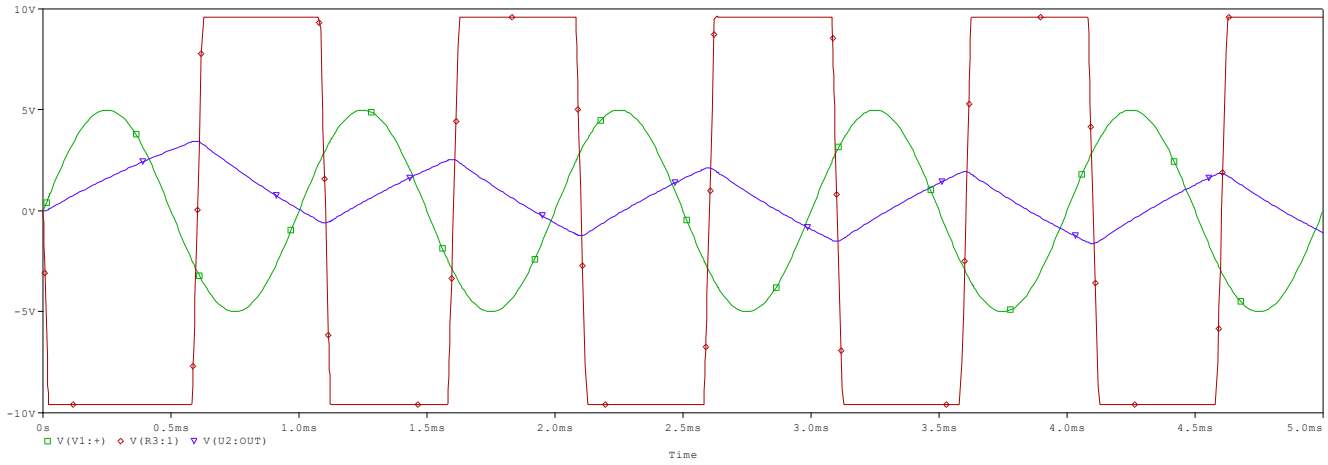
Output: square wave

Result of the second segment:



Input: square wave ***Output:*** Triangular wave

Final Output :



Conclusion :

In summary, this project taught us how to use an operational amplifier to create a square waveform from a sine input and a triangular waveform from a square input. While putting this project together, we learned more about the Schmitt Trigger and Integrator circuits.