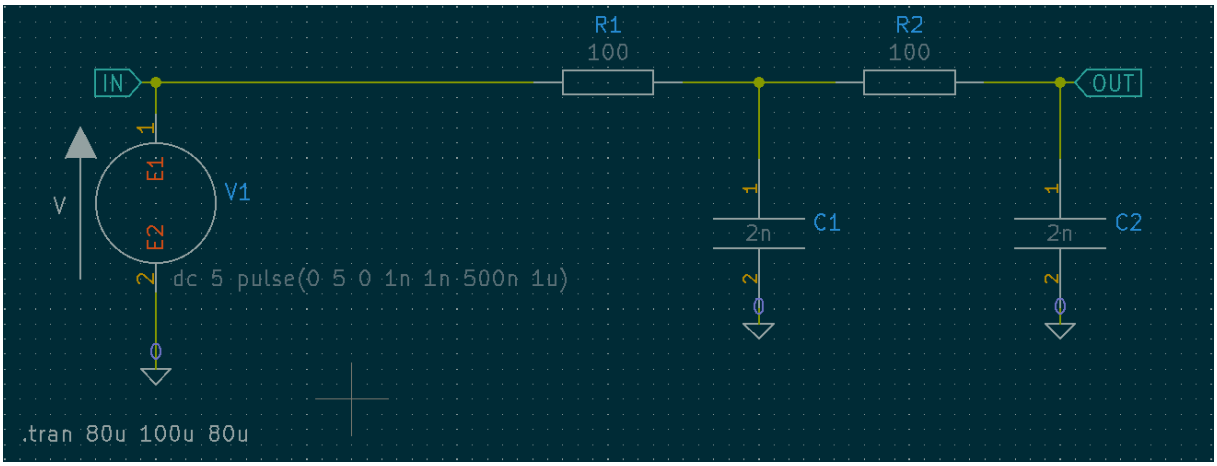
GRADUATION PROJECT-1

TRIANGULAR WAVE GENERATOR CIRCUITS REPORT

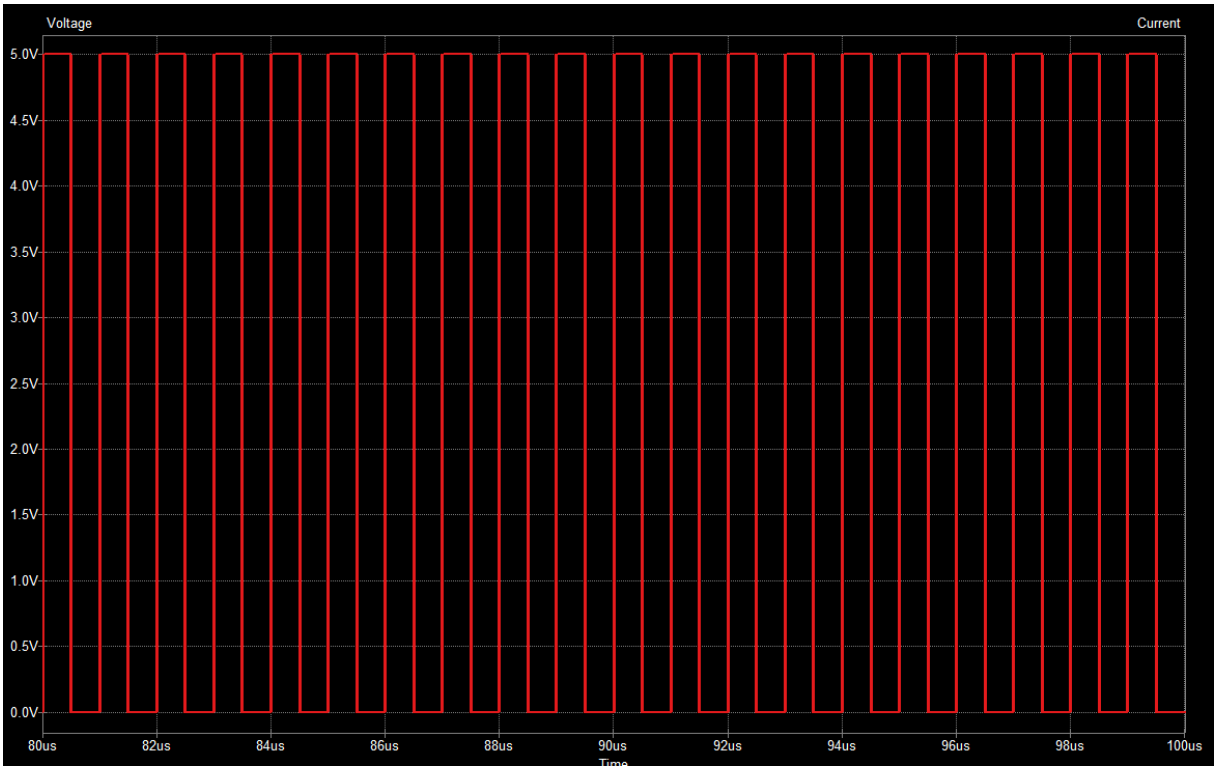
Name: Osman Alperen Kayasaroğlu

ID: 16050511011

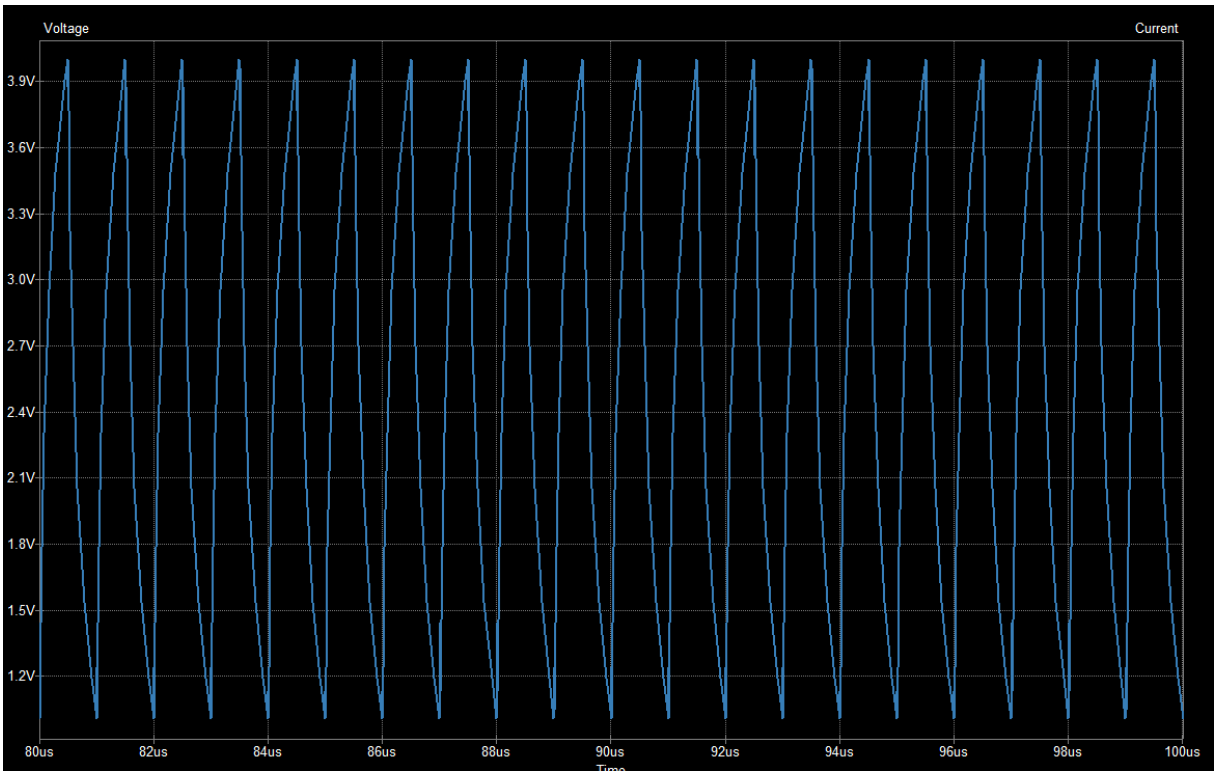
1. RC NETWORK TWG



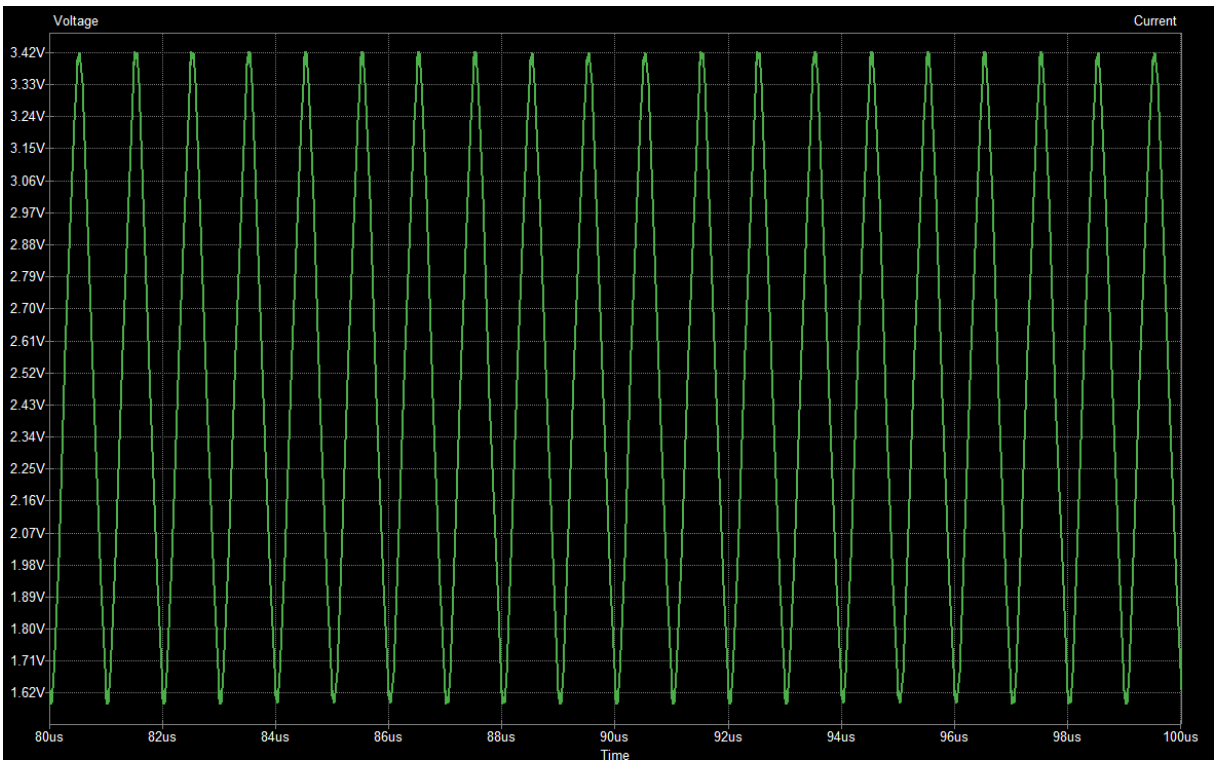
This circuit is a square wave to triangle wave converter circuit consisting of two RC Networks. The first RC network consists of R1 and C1 components, and the second RC network consists of R2 and C2 components.



A square wave with a frequency of 1MHZ and an amplitude of 5 volts comes from the voltage source.



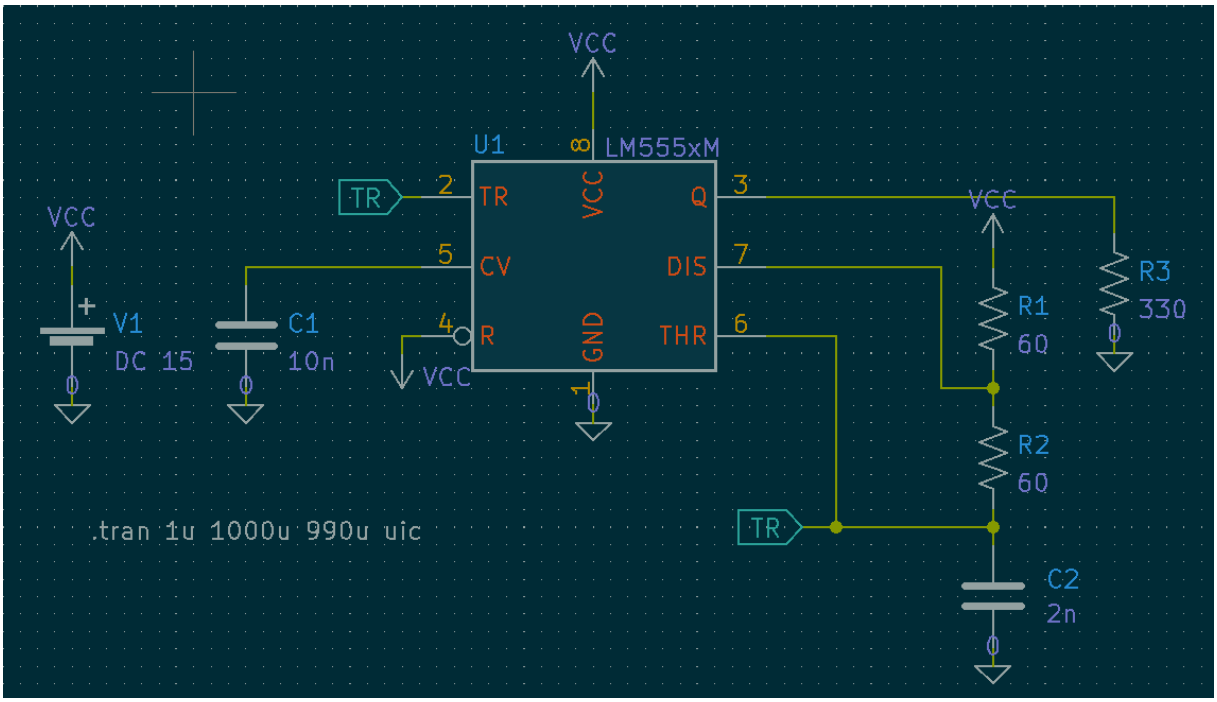
This is how the signal from the source looks after it has passed the first RC Network. However, this figure does not exactly represent a triangular wave.



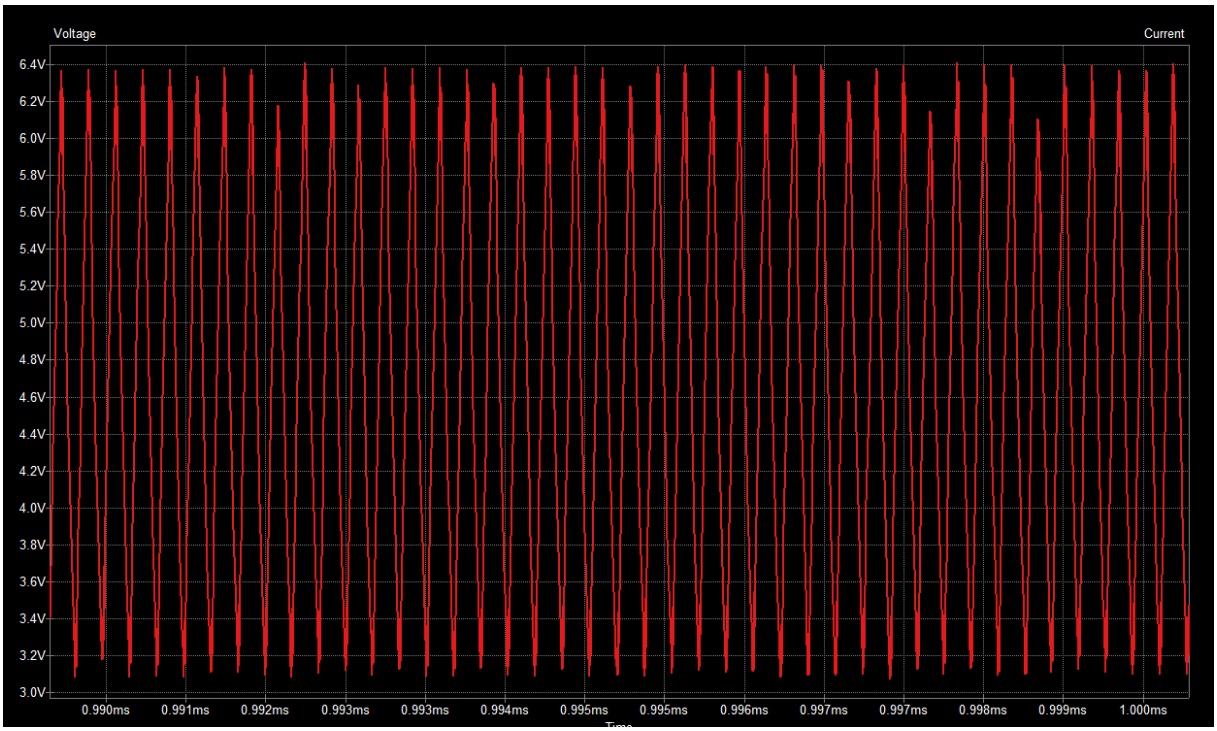
What you see in this figure is the final signal passing through the second RC Network. A regular triangular wave with an amplitude of 1.8 volts and a frequency of 1MHz was successfully formed.

While preparing this circuit, I often used the formula $VC = VIN(1 - e^{-\frac{t}{RC}})$. The resistors in this circuit must be re-adjusted at every frequency change, otherwise the triangular form of the output signal will change. The peak voltage of the output signal is smaller than the peak voltage of the input signal, which means there are losses in the circuit.

2. 555 Timer TWG

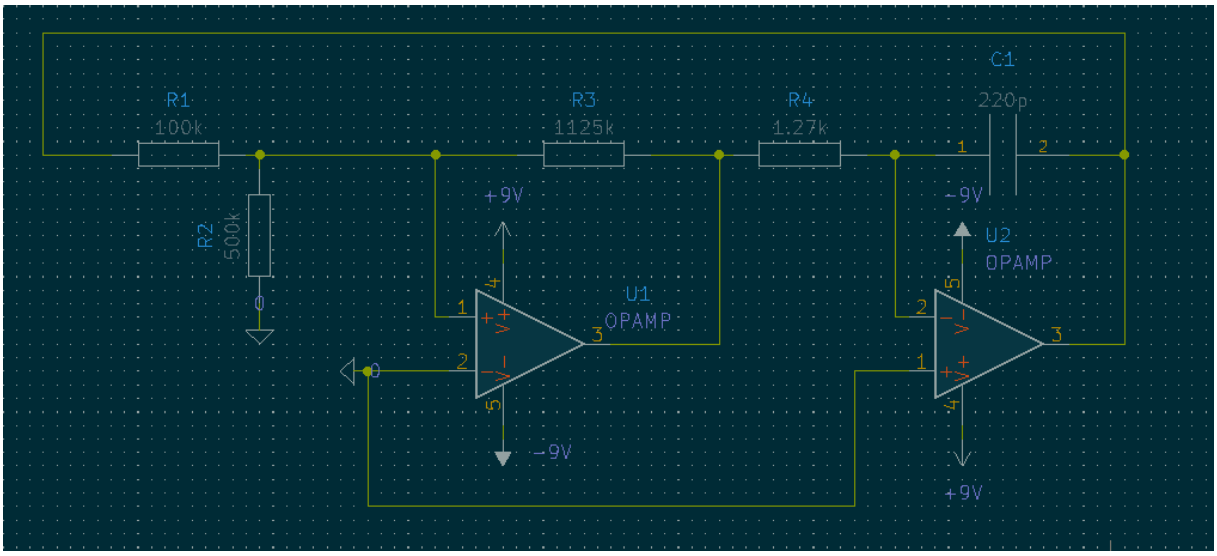


What you see in this circuit is a triangle wave generator created with a 555 timer. I found the SPICE model of the integrated circuit from the pspice library in the trial version of OrCAD and integrated it into KiCAD, I built this circuit with the information I got from literature survey and internet research. I can adjust the frequency by playing with the value of C2 or R2, but I couldn't adjust the amplitude in any way.

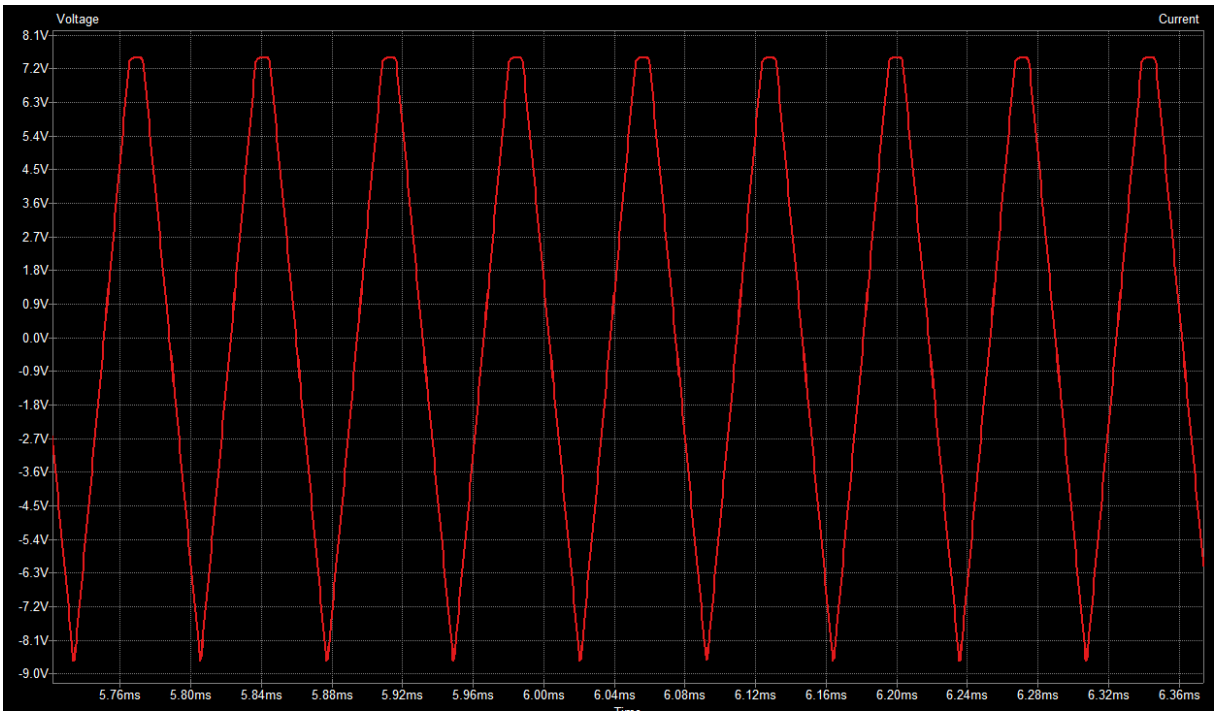


In the figure you see a triangular wave with an amplitude of 3.2 volts at a frequency of about 4.5 MHz. None of these triangle waves are exactly the same, so this circuit established with a 555 timer does not give a stable output.

3. Op-Amp Circuit 1

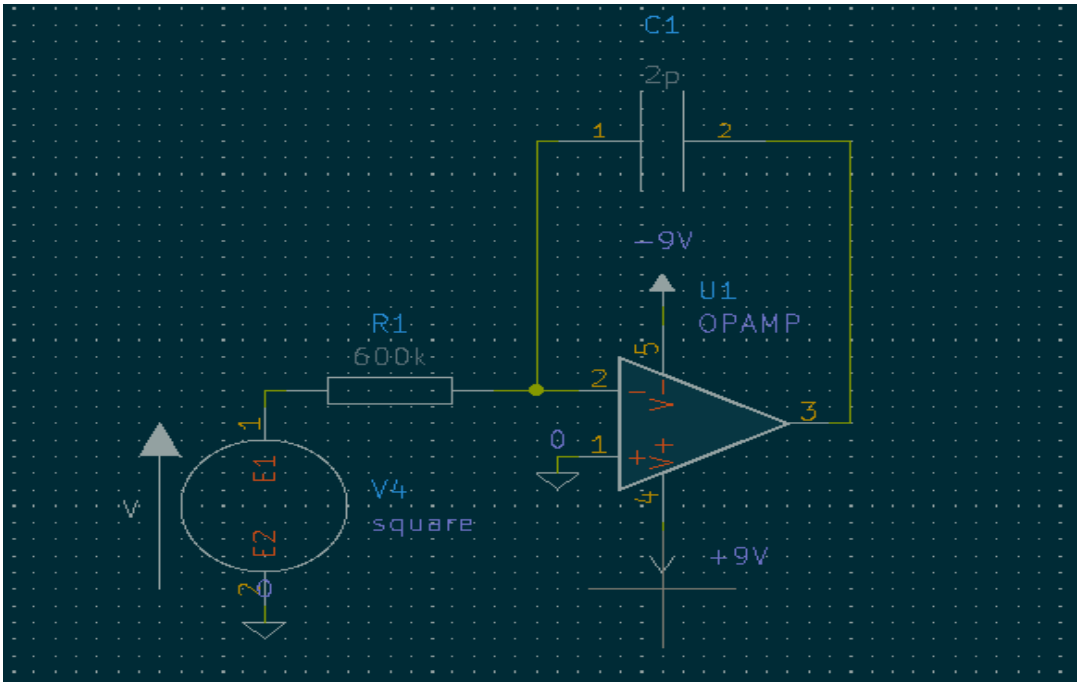


I found this circuit on the internet as the internal structure of a Maxim Integrated brand triangle wave generator IC and tried to adjust the frequency and amplitude according to my own desire by applying the formulas in the article.



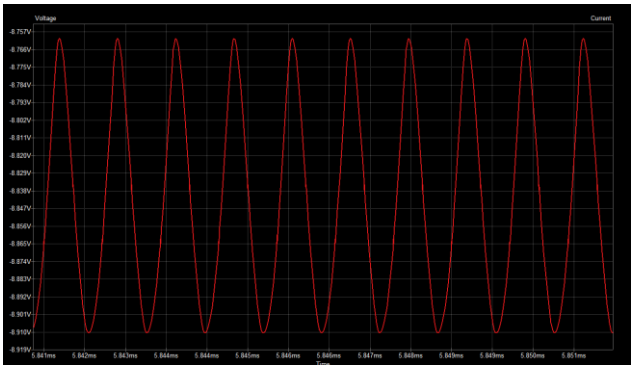
I was able to adjust the amplitude as I wanted, but not the frequency. Moreover, although the lower peaks of the triangle wave are sharp, the upper peaks seem to be clipped. I couldn't get a true triangle waveform.

4. Op-Amp Circuit 2



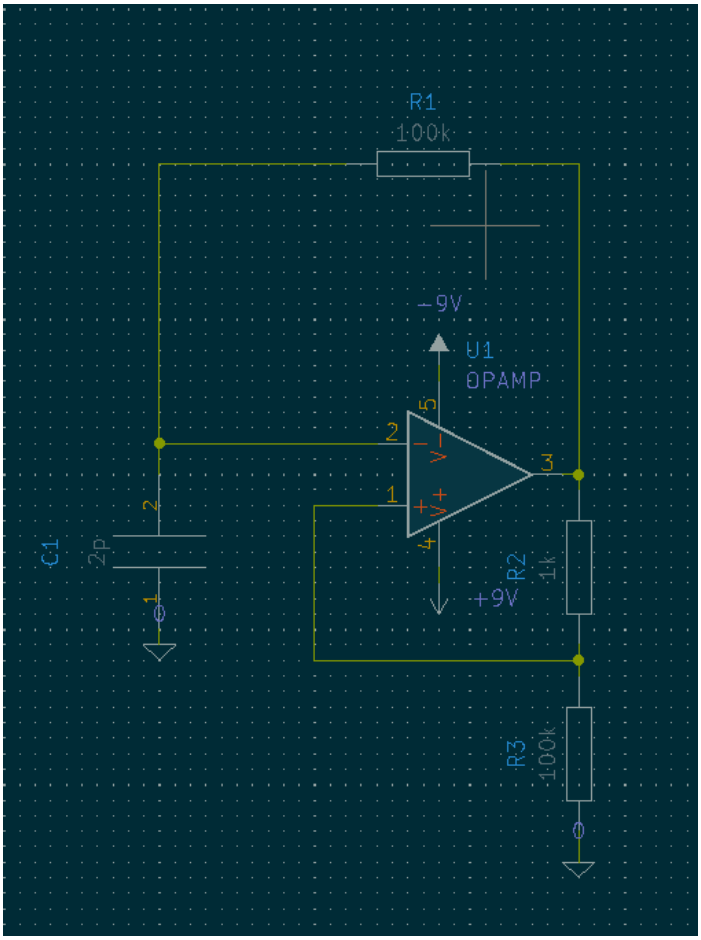
In this circuit, I tried to convert a ready-made square wave into a triangle wave with the Op-Amp integrator circuit.

But I encountered a lot of loss in simulation results. Moreover, the voltage range decreases continuously at the beginning and then takes a constant value. I think I can overcome the loss by installing a second Op-Amp circuit.

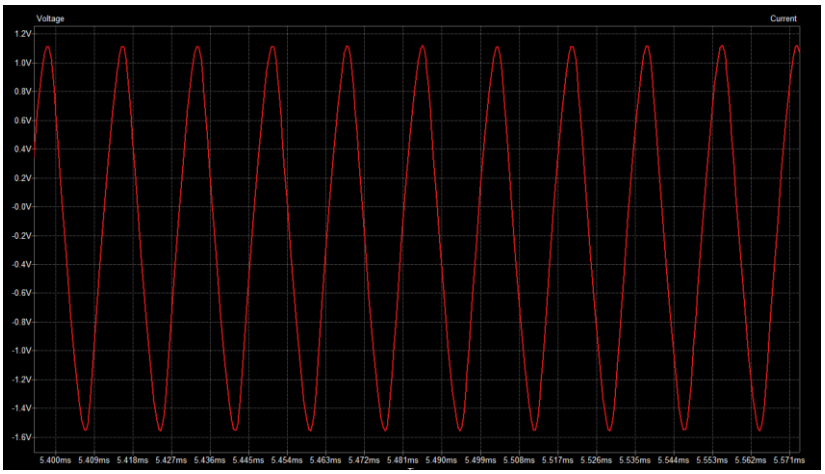


When I zoom in on the signal enough, we see an output similar to a triangle wave at a frequency of 1 MHz with an amplitude of 200 milliVolts. However, I was not satisfied because the lower and upper peaks were not sharp enough.

5. Op-Amp Circuit 3



In this figure, I generated triangular waves by playing with the values of the elements in the square wave generator circuit with the Op-Amp.



At the output, I got a signal with an amplitude of 2.6 volts and a frequency of 50 KHz. When I increase the frequency, the shape of the signal starts to distort. I can handle the amplitude by building another Op-Amp circuit. Peaks are not sharp enough.

6. Summary

I can get a decent output with RC network, but tuning seems unlikely. I could not produce a stable signal in the 555 circuit. I think that the cause of the deformities in the Op-Amp circuits is due to the Op-Amp SPICE Model I use. I can get right results by changing the SPICE model.

7. References

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