

Mixed signal triangular wave generator

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Abstract— Generally, a triangle waveform's rise and fall slopes are identical. This usually occurs if no specification is provided. This results in a 50% duty cycle for the waveform. Due to its harmonic richness and intriguing sound, the triangle waveform is frequently utilized in musical instruments. We will be seeing the implementation of a triangular waveform generator using a square wave generator(baud rate generator) using Verilog and an integrator using an op-amp made of SKY130nm simulated using kicad and esim tool.

Keywords—Triangular waveform generator, integrator, baud rate generator.

I. INTRODUCTION

An audio waveform is theoretically comprised of an infinite set of odd harmonic sin waves. It is often used in the *sound synthesis* where its timbre is less harsh than the square wave because the amplitude of its upper harmonics falls off more rapidly. In terms of sound, a square wave with many harmonics produces a harsher sound than a triangle wave. We can observe in figure 1 that a basic triangular waveform is made of 2 main components namely a square wave generator and an integrator to convert the square wave to the triangular waveform.

Figure 1[done in paint]

II. CIRCUIT/BLOCK DETAILS

A. Square wave generator(digital block)

Firstly, we will use a baud rate generator for getting a square for the required frequency from a fixed clock(XTAL or crystal oscillator). We can see the basic baud rate generator in figure 2, we will be using the standard baud rate values i.e., 2400, 9600, 115200, etc.

B. Integrator(analog block)

Integrator is made of 3 main components a resistor, a capacitor, and an op-amp(SKY130nm transistors). we can observe this in Figure 2.

The opamp design has 5 PMOS transistors and 3 NMOS transistors.

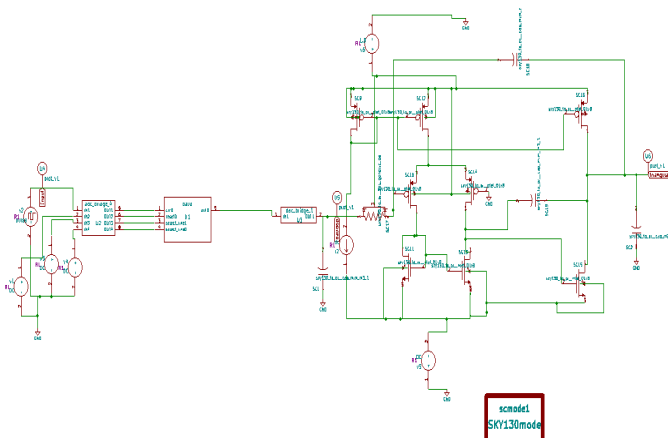


Figure 2

Figure 2, shows the esim implementation of the triangular wave generator with digital and analog blocks.

III. WAVEFORMS

we can see the input in figure 3 and the output stages of output in figure 4 and 5, We will be attaining the triangular output waveform with respect to the input square wave and the baud rate set.

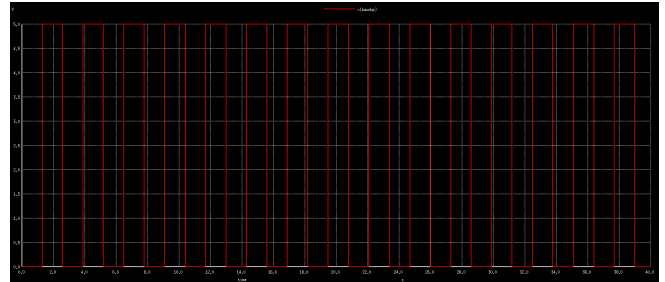


Figure 3

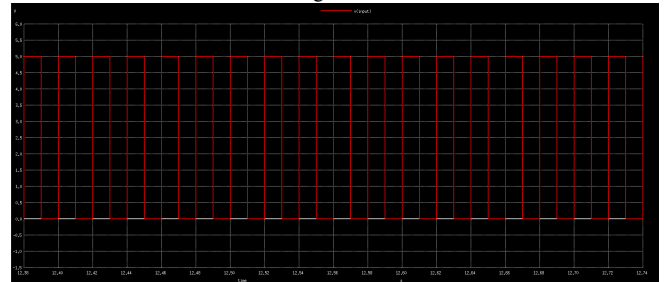


Figure 4

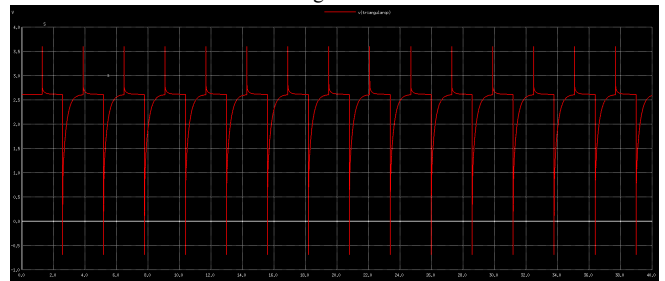


Figure 5

IV. REFERENCES

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