SQUARE WAVE GENERATOR USING CMOS OPAMP AND SKYWATER130 PDK

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Abstract- *This paper presents the design and implementation of a CMOS OPAMP-based square wave generator using Esim software and the SKYWATER 130 library. The behaviour of the proposed circuit was tested in design implementation. This paper contains the final generated waveforms. The results obtained are satisfactory to its theoretical calculations.*

Keyword- CMOS, Square wave generator(SWG), operational amplifier(OP-AMP),SKYWATER 130 PDK, NGSPICE, ESIM

1. INTRODUCTION-

Square wave signals find application in various electronic systems. Digitally tuning the output frequency of square-wave generators, offer flexibility when used with digital machines. Square wave can define as a non-sinusoidal periodic waveform that can be represented as an infinite summation of sinusoidal waves. It has an amplitude alternate at a regular frequency between fixed minimum and maximum value with the same duration. Square wave generator is generally used in electronics and in signal processing. The square wave is the special case of rectangular wave.

2.0 CIRCUIT DETAILS-

2.1 CMOS OPAMP

The square wave generator circuit contains op-amp , this op-amp is made up using CMOS models. The circuit of CMOS operational amplifier is shown below figure[1]. This circuit contains PMOS , NMOS, Capacitor, and a current source respectively.

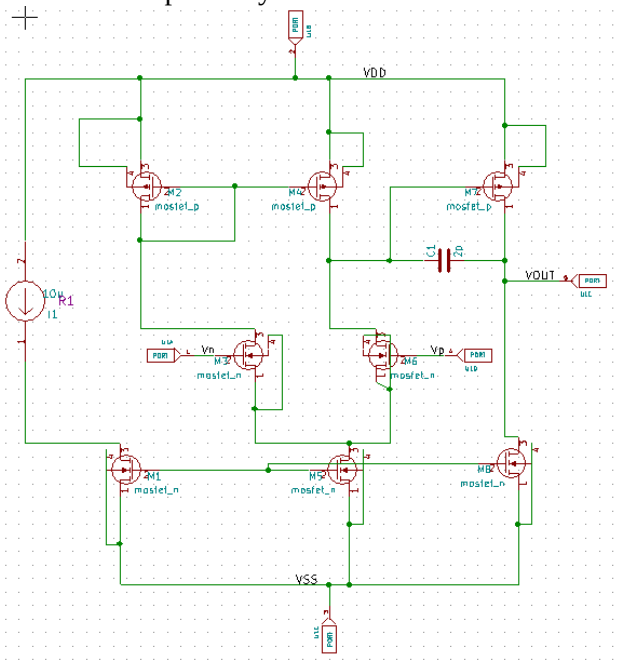


FIGURE 1. CMOS BASED TWO STAGE OPERATIONAL AMPLIFIER

2.2 SUBCIRCUIT

To use CMOS OP-AMP in square wave generator circuit , it must be created as subcircuit model . the subcircuit Tab in ESIM can make any circuit to component model. The component model of CMOS OPAMP has been shown below in figure 2

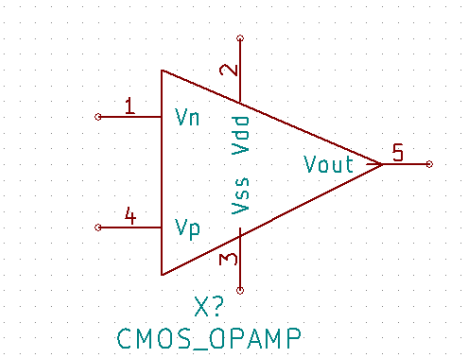


FIGURE 2. SUBCIRCUIT COMPONENT MODEL OF CMOS OP-AMP

2.3 SQUARE WAVE GENERATOR CIRCUIT

The square wave generator can also be called as Astable multivibrator. The circuit for Astable circuit has been shown below figure 3. The circuit contain subcircuit model of cmos opamp and two dc sources to drive VSS and VDD .Observe that in the circuit diagram shown below, the resistor R1 is connected between the inverting input terminal of the op-amp and its output of op-amp. So, the resistor R1 is used in the negative feedback. Similarly, the resistor R2 is connected between the noninverting input terminal of the op-amp and its output. So, the resistor R2 is used in the positive feedback path.

A capacitor C is connected between the inverting input terminal of the op-amp and ground. So, the voltage across capacitor C will be the input voltage at this inverting terminal of op-amp. Similarly, a resistor R3 is connected between the non-inverting input terminal of the op-amp and ground. So, the voltage across resistor R3 will be the input voltage at this non-inverting terminal of the op-amp.

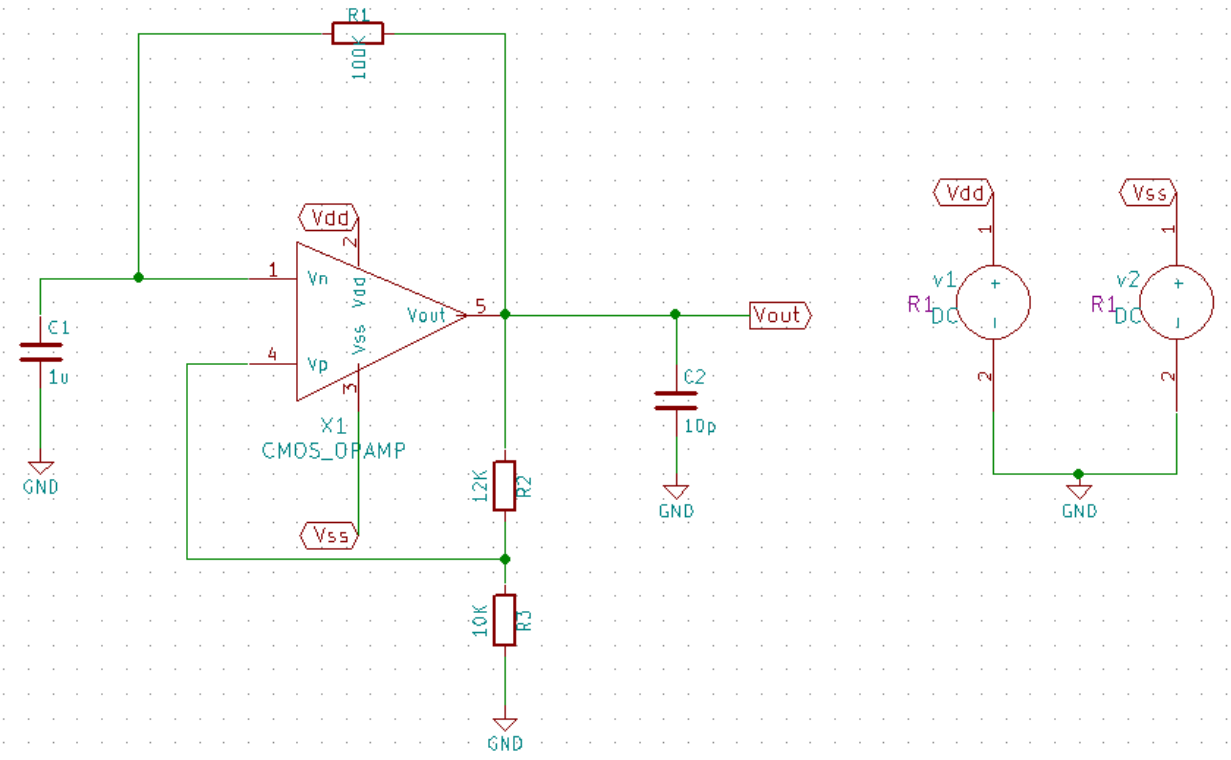
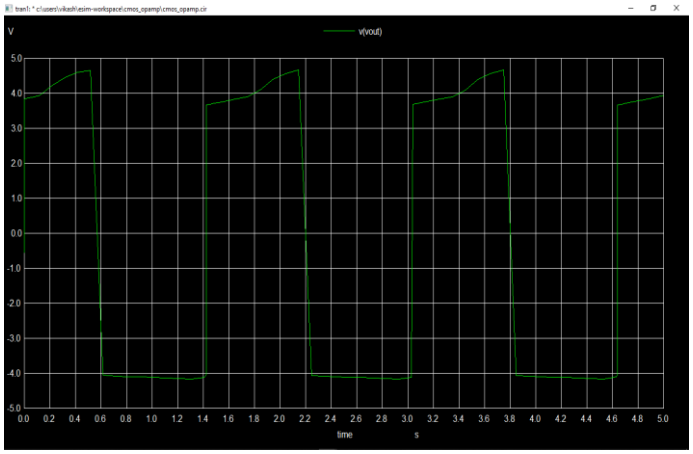


FIGURE 3. CIRCUIT DIAGRAM FOR SQUARE WAVE GENERATOR IN ESIM

3.0 IMPLEMENTED WAVEFORMS

3.1 NGSPICE PLOT



FIGUER 4. NGSPICE PLOT OF SWG WITH SKYWATER130 PDK

3.2 PYTHON PLOT

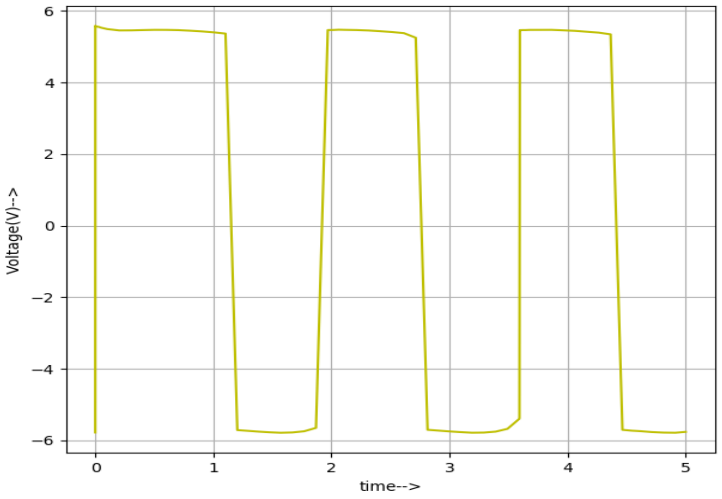


FIGURE 5. PYTHON PLOTS OF SWG

4.0 CONCLUSION

The square wave generator is defined as an oscillator that gives the output without any input, without any input in the sense we should give input within zero seconds that means it must be an impulse input. In this paper the aim of the design methodology is to implementation of cmos opamp based square wave generator. The cmos opamp is made using the SKYWATER 130 PDK model library, The presented paper simulation results have been obtained by 130nm CMOS technology. and transient analysis is done using NGSPICE. As the simulation shows the square wave generator circuit works perfectly. This generator is used in digital signal processing and electronic applications.

5.0 REFERENCES

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