# Design and Development of CMOS Oscillator Using MRKTAN PairAmplifier

Arunendra Nath Tripathi[1] Raj Kumar Tiwari[2] Monika Tiwari[3]
[1] *Research Scholar, Department of Physics &Electronics,Dr. RammanoharLohia Avadh University, Ayodhya.*
[2] *Professor, Department of Physics & Electronics, Dr. RammanoharLohia Avadh University, Ayodhya.*
[3]*Lecturer RajkiyaPolytecnicGonda U.P. India*

oscillator to work at very low voltage with sustainable frequency has been important and challenging task for researcher. To achieve this task researcher, use various methodology. In present work we have designed a new LC oscillator using inverted CMOS compound pair which is operating at few micro volts at sustainable frequency from few hertz to tera hertz at very minute power consumption of 5 Pico watt.
**Keywords - MRKTAN pair Amplifier, frequency response, power losses, high speed, low noise, temperature stability**

---

Date of Submission: 10-08-2022 Date of Acceptance: 26-08-2022

---

## I. INTRODUCTION

Manufacture of high-quality CMOS LC oscillator which can maintain sustainable high frequency and to operate withlow covering area, low power consumption low noise figure is high demanded in Radio Frequency Communication. [**cta3006**] Lastfew decades CMOS technology has played very important role in development of nano-science and nanotechnology with increased integration of VLSI and ULSI systems [1]. Due to bigger fan-out capability, minute power dissipation, very high noise immunity. Thus, one can get outcome of high speed of TTL with high density of CMOS with suitable compromise between these two as per applications area [2]. Thus, CMOS is very useful for quick development of portable system as laptops; digital wrist watches, pace maker, ECG and high frequency cell phones in coming future which required low power consumption and high density of integrated circuits together with very high speed. As a result, there is necessary of innovations and development in low power consumption devices and design techniques. In mostly cases the requirement for low power consumption is demanding goal with high chip density. Hence low power digital design, digital ICs and their simulation is very important and challenging field for research and development [3] [4]. Seeing above merits of CMOS circuits and devices to achieve ultra-low power and very high frequencies, we utilize MRKTAN pair amplifier recently developed by us to design high frequency oscillator with very low power loss and good temperature stability.[5][6]

**[a] Oscillator**

Oscillator is the basic key element for all ac signal source and generates harmonic signal for knownfrequency and amplitude.it is one of most important keys of electrical and electronic communications and measurement. Oscillator covers the frequency range form few Hertz to Tera Hertz.[7] when we speak of an oscillator it means generating a sinusoidal signal. But it is to be noted that it does not create energy but merely at as an energy converter. [8]to design an oscillator, an oscillator must have the following three elements

(a) Amplifier
(b) Oscillatory circuit or elements
(c) Feedback network

The basic block diagram of an oscillator is given below

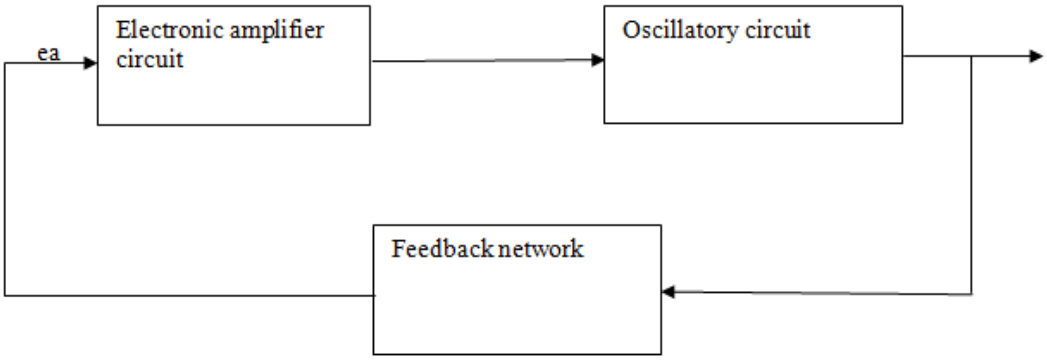



**Fig-** Basic Block diagram of an Oscillator

To start the oscillations, value of the closed loop gain should be higher than 1. When oscillation begins, Barkhuizen Criteria must be satisfied to sustain stable oscillation, but RKTG pair-based oscillator could not be satisfied the Barkhuizen Criteria.

MRKTAN pair-based oscillator are composed a number of CMOS inverters or delay stages connected to each other in the form of a chain, with the output of the last stage fed back to the input of the first. Each inverter consists of a NMOS and PMOS transistor one.[9]

**Circuit analysis**

The circuit diagram of RKTGpair-based reference oscillator is shown in Fig.1 it consists of RKTG pair amplifier circuit, feedback network and output circuit which provide a close loop system.

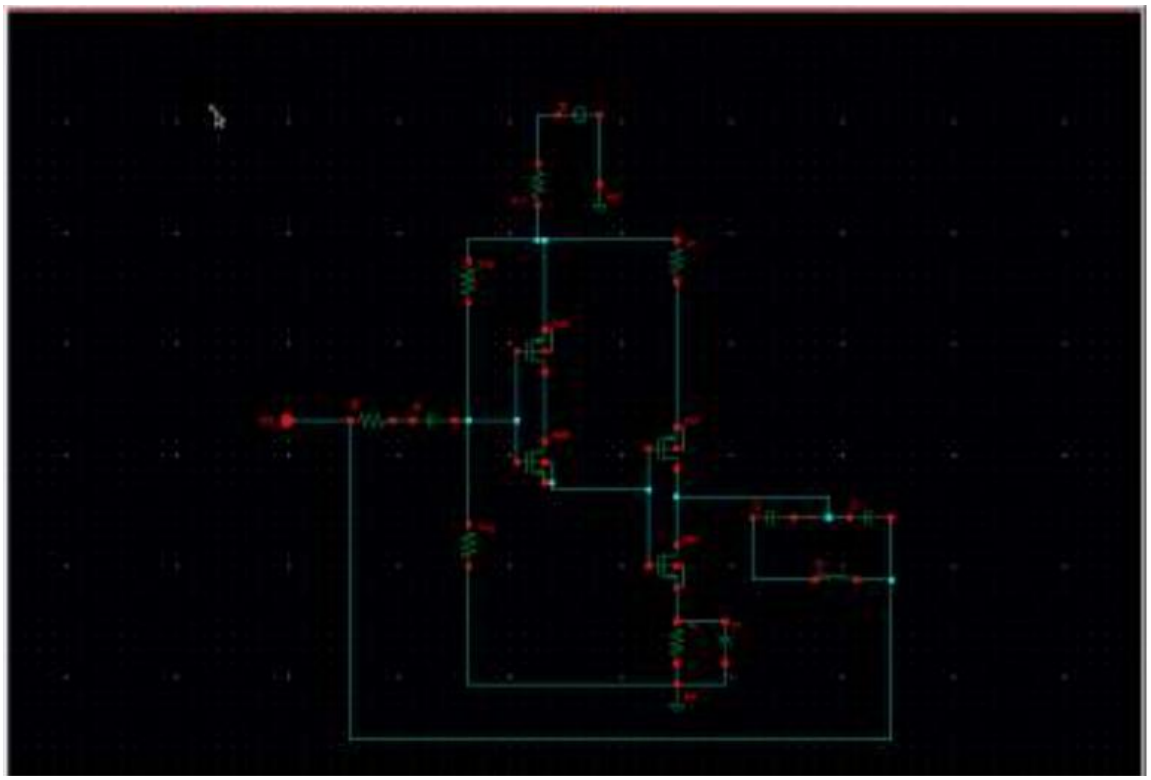
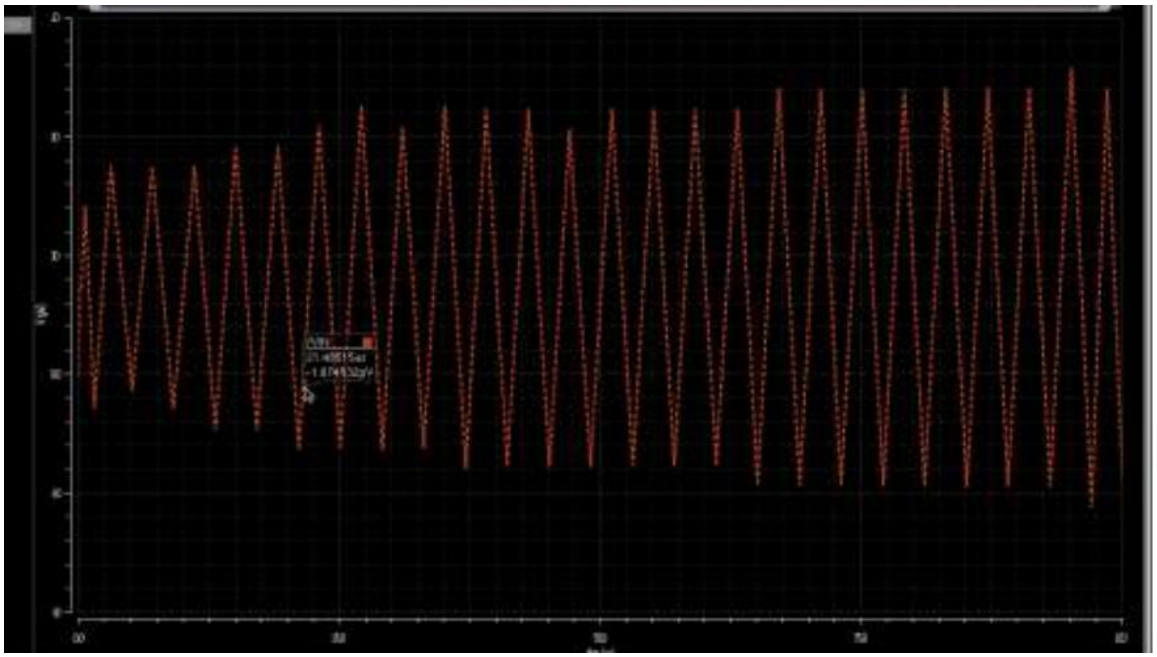
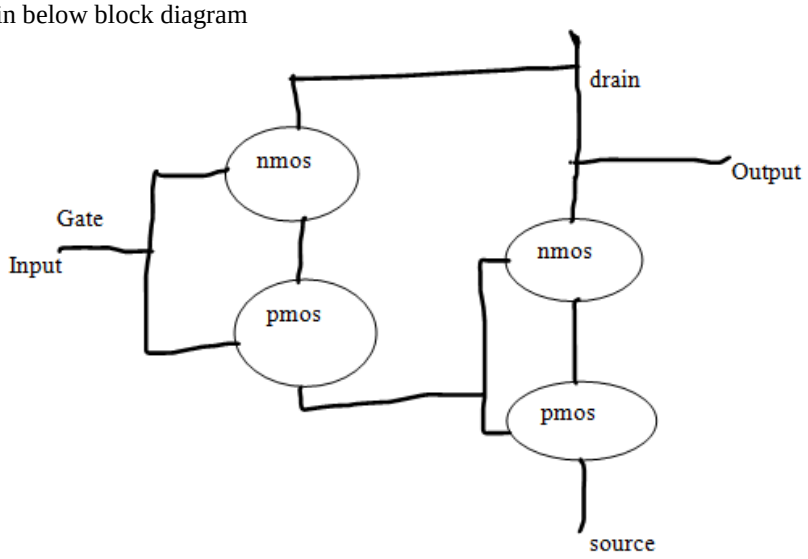


**Fig-** reference circuit of RKTG pair- based oscillator

But the major drawback of this oscillatory circuit outputs cannot finduniform oscillation after some nanosecond is become uniform it shown in below figure



This drawback can be resolved by RKTG pair replaced by proposed MRKTAN pair -based oscillator circuit with proper choice of circuit components. This pair made by using the combination of two NMOS and two PMOS as shown in below block diagram




The circuit consist of a CMOS as a combination of NMOS(Length=180 nm, width=2 µm threshold voltage= 800nm) and PMOS (Length=180 nm, width=2 µm threshold voltage= 800nm) is used as an active component to design the circuit having proper biasing with resistance $R_1$=47 KΩ and $R_2$=10 KΩ. DC power supply (Vdc=2V), Drain resistance ($d_r$=10KΩ) input capacitor ($C_i$=100µf), input resistance ($R_i$=500Ω), source resistance ($R_S$= 2KΩ) bypass capacitor ($C_S$=10µf) load resistance ($R_L$= 80KΩ) and most important component of the circuit having tank circuit with C= 50µfand L= 50 µH. Here we have studied the transient analysis with stop time 100ms.All the simulation work have been carried out by cadence software180nm.

Proposed MRKTG pair oscillator circuit provides good transient response with stop time 100 ms. Simulated result is shown in fig.3. So, the proposed oscillator circuit is used with proper choice of component to provide the wide range frequencies. This circuit works at 20- picowatt power dissipation. Table-1 shows the Output voltage variation of MRKTAN pair oscillator circuit with time.

Table-2 shows the Output voltage variation of MRKTAN pair oscillator circuit at with frequency.

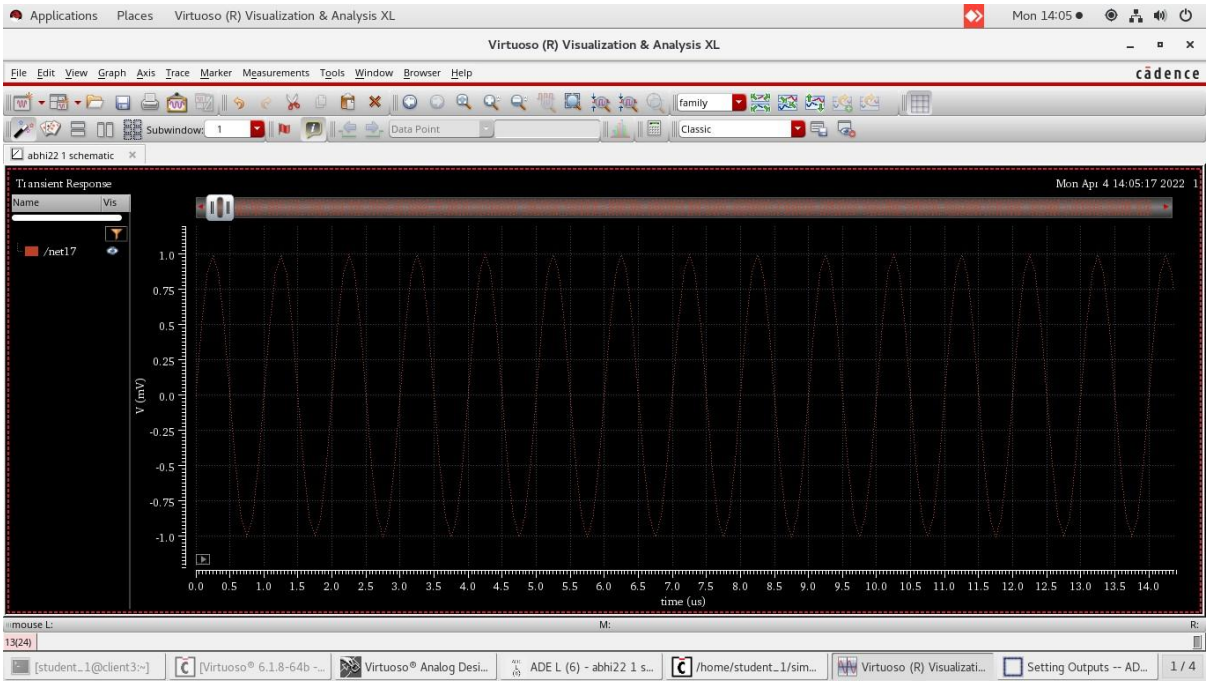



**Fig.3 Output of MRKTAN Oscillator with time in micro second range.**

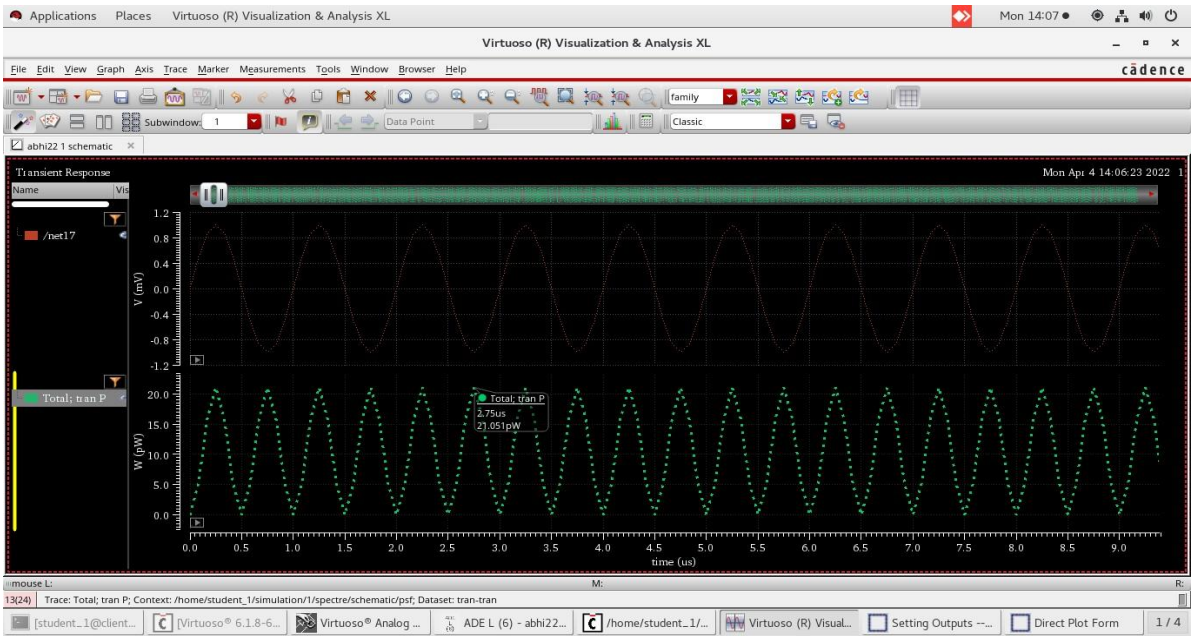



**Fig.4 Power consumptions in picowatt.**

## II. CONCLUSION

From above discussion it is concluded that the MRKTAN pair circuit played an important role with proper choice of the circuit element. The circuit work as an oscillator circuit for higher frequency with 20-picowatt power dissipation which can be useful for 5th generation mobile communication system in coming future and various communication system. Thus, solving real challenges in the future, we have designed and simulated MRKTAN pair circuit with the addition of few other circuit elements to yield high frequency high speed with low power loss oscillator with wide band of frequencies upto 50 Hz which may be extended upto 135 THz or more for which further work is going on. It is seen that such circuit are useful for functional integration rather scale integration.

**Acknowledgment**

This work is supported by the grant from the Major Research Project of University Grant Commission (UGC) New Delhi (Project ID.MRP-MAJOR-ELEC-2013-31956). Authors are thankful to University Grant Commission to provide financial support.

## References

[1]. P. H. Siegel, "Terahertz technology," IEEE Trans. Microw. Theory Tech., vol. 50, no. 3, pp. 910–928, Mar. 2002.

[2]. P. H. Siegel, "Terahertz technology," IEEE Trans. Microw. Theory Tech., vol. 50, no. 3, pp. 910–928, Mar. 2002.

[3]. E. Seok, D. Shim, C. Mao, R. Han, S. Sankaran, C. Cao, W. Knap, and K. O. Kenneth, "Progress and challenges towards terahertz CMOS integrated circuits," IEEE J. Solid-State Circuits, vol. 45, no. 8, pp. 1554–1564, Aug. 2010.

[4]. Tiwari, Raj Kumar, Shiksha Jain, and Gaya Prasad. "Complementary Compound Push Pull Power Amplifier for Wide Frequency Band Applications Using CMOS Nanotechnology." *2020 International Conference on Electrical and Electronics Engineering (ICE3)*. IEEE, 2020.

[5]. Raj Kumar Tiwari, Gaya Prasad, "A New Circuit Model of Low Voltage High Current Gain CMOS Compound Pair Amplifier" IJECET-2014, volume 5, issue 4, April 2014, pp.65-71.

[6]. C. Cao and K. O , "A 140-GHz fundamental mode voltage-controlled oscillator in 90-nm CMOS technology," IEEE Microw. Wireless Compon. Lett., vol. 16, no. 10, pp. 555–557, Oct. 2006.

[7]. C.-C. Chen, C.-C. Li, B.-J. Huang, K.-Y. Lin, H.-W. Tsao, and H. Wang, "Ring-based triple-push VCOs with wide continuous tuning ranges," IEEE Trans. Microw. Theory Tech., vol. 57, no. 9, pp. 2173–2183, Sep. 2009.

[8]. Raj Kumar Tiwari, Gaya Prasad and Monika Tiwari, "Low Input Voltage High Gain Wideband CMOS Push Pull Amplifier for Tuned High Pass Filter," International Journal of Research in Electronics & Communication Technology, Volume-2, Issue-3, MayJune, 2014, pp. 27-31, © IASTER

[9]. Raj Kumar Tiwari and Jyotsna Mishra, "A New Circuit Model for Distortionless Push-Pull Amplifier" in Bulletin of pure and applied sciences, An International Journal of Physics, Vol.29D(No.1) JanJune 2010.