Design of Capacitor Controlled Oscillator with the help of Operational Trans Resistance Amplifier

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Abstract—This research paper introduces a fully controllable Oscillator and Operational Trans Resistance Amplifier (OTRA)and six passive components consist of three Resistors And three Capacitors . Workability of all thesimulators are tested by 0.5μm CMOS Technology.

Keywords—*Operational Trans Resistance Amplifier,Oscillator*

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I. INTRODUCTION

The operational Transresistance amplifier (OTRA) plays a very important role as an active element in analog integrated circuits due to their low input and output impedances which eliminates limitations of response time due to capacitive time constants. Both input terminals are internally grounded, thereby purge parasitic capacitances of the input. OTRA has the benefits of a high slew rate &extensive bandwidth. The OTRA is generally a three port analog building block besides the power terminals.

In this paper,the capacitance controlled oscillator is planned using one OTRA and six passive components consisting of three resistors and three capacitors.

II. CIRCUIT DESCRIPTION

The symbol of OTRA and its corresponding CMOS circuit is given respectively in Fig.1 and Fig.2. Its port relations are shown below:

$$\begin{bmatrix} V+ \\ V- \\ Vo \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ Rm & -Rm & 0 \end{bmatrix} \begin{bmatrix} I+ \\ I- \\ Io \end{bmatrix}$$

$V = V- = 0$

$V0 = Rm(I+ - I-)$

And Rm→∞ therefore,1/Rm=0

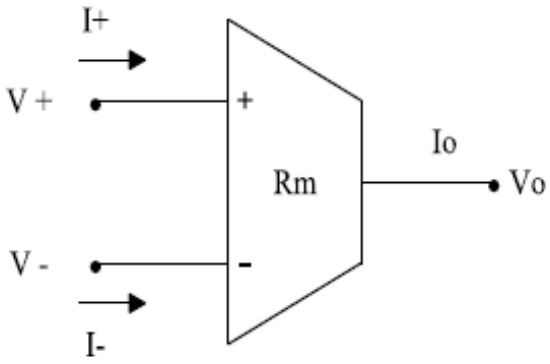

Fig1:Block Diagram Of OTRA

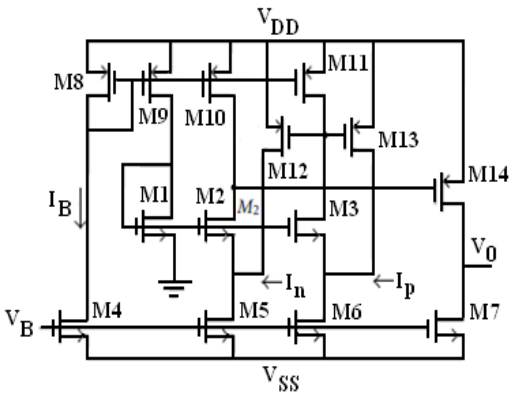

Fig 2:Internal Circuit of OTRA Using CMOS

The proposed capacitance controlled oscillator using OTRA is shown in Fig 3

The routine analysis results an expression of input current In asIn=VC1S+V0/R1

and that of input current Ip is given by

Ip=V/R3+V0/R2

and that of output voltage V0 is given by

V0 =Rm(V/R3+V0 /R2-V0 /R1-VC1S)

Which is obtain by putting the values of Inand Ip in the equation V0 = Rm(Ip – In)

And (VZ-V)C2S=VC1S+V/R3+VC3S

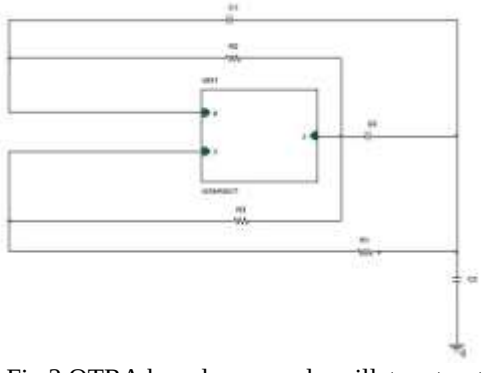

Fig 3 OTRA based proposed oscillator structure

Now solving the three equations we obtain the characteristic equation of the oscillator which is given by:

$R1R2R3C1C2S^2+(R2R3C1+R2R3C2+R2R3C3-R1R3C1-R3R1C2-R1R3C3-R1R2C2)S+(R2-R1)=0$

And the condition of the oscillation can be obtain by making the S=0 which is given by:

$R2R3C1+R2R3C2+R2R3C3-R1R3C1-R3R1C2-R1R3C3-R1R2C2=0$

And the frequency of the oscillation is given by:

$Frequency=1/2\pi(\sqrt{(R2-R1)/R1R2R3C1C2})$

[where, R1,R2,R3 are the resistors and C1,C2,C3 are the capacitors]

III. SIMULATION RESULT

The PSPICE simulations given in this paper are performed using OTRA based on CMOS given in Fig.3. Model parameters, supply voltages and L and W of transistors are obtained from MIETEC 0.5 μm CMOS process. To implement 1KHzfrequency the passive elements of C1=150pF, C2=100pF, C3=120pF, R1=3kΩ and R2 = 10kΩ, R3=20kΩ are used.

MOS Dimensions Used In This Circuit

TRANSISTORS	W (μm)	L (μm)
M1-M3	100	2.5
M4	10	2.5
M5,M6	30	2.5
M7	10	2.5
M8-M11	50	2.5
M12,M13	100	2.5
M14	50	2.5

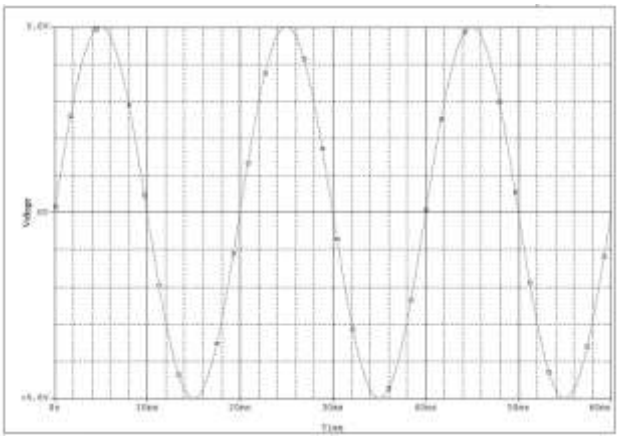

Fig 4 Simulation of proposed oscillator

IV. CONCLUSION

In this paper the proposed circuit use only one OTRA and a few passive components, and the proposed circuit is simpler than the voltage-mode (op-amp based) waveform generators. Both the simulated and experimental output waveforms are given in Fig. 4. The main advantage of the proposed circuit is less number of passive components, grounded capacitor which is useful for integrated realization. The percentage of Total Harmonic Distortion (THD) for the proposed circuit is within the acceptable limit. Taking these advantages into consideration, the proposed circuit can have wider applications in many fields of electronics, signal processing and for instrumentation applications.

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