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Design and Simulation of High Performance High Pass Filter at 45 Nm Technology Node

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Abstract: In this work, cascode operational transconductance amplifier based High Pass filter is proposed using advance technology. Cascode Operational Transconductance Amplifier (COTA) is a new class of operational amplifier (OP-AMP). Flexibility and the tunability are the big advantages of COTAs. It has been designed and simulated using novel Carbon Nano Tube (CNT) based MOS structures and conventional MOSFETs at 45nm technology node. The proposed structure is useful for analog applications in nano electronic circuits. It is observed that the proposed HPF is also consuming low power of 129 nW. The proposed HPF is simulated using 0.9 V.

Keywords: CMOS, CNTFET, DC gain, Cascode -OTA, Power consumption, Filters, HPF

I. INTRODUCTION

Cascode amplifier configuration improves gain (due to high output resistance) and bandwidth due to reduced Miller capacitance. In order to ensure further improvement in Cascode OTA performance with sustaining Moore's Law, we have proposed Carbon Nanotube Field Effect Transistors (CNTFETs) based Circuits that promise to deliver much better performance than existing CMOS based Cascode Operational Transconductance Amplifiers. CNTFET technology can easily club with the bulk CMOS technology on a single chip and utilizes the same infrastructure at 45nm[1-7].

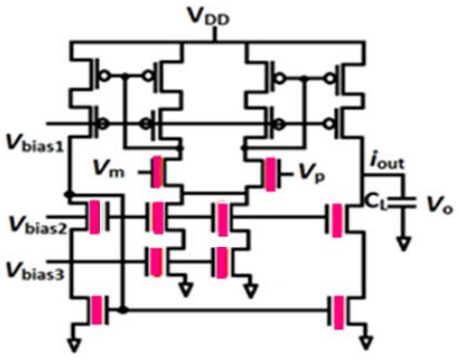
II. CASCODE OPERATIONAL TRANSCONDUCTANCE AMPLIFIER (COTA)

Operational transconductance (OTA) is a voltage controlled current source, it takes the difference of the two voltages as the input for the current conversion. There is an additional input for a current to control the amplifier's transconductance. Operational Transconductance Amplifier (OTA) is a new class of operational amplifier (OP-AMP). Flexibility and the tunability are the big advantages of OTAs. OTA has more advantages compared to OP-AMP like higher input-output isolation, higher input impedance, high output impedance, higher gain or higher bandwidth with additional applications. The output current io of the ideal OTA can be expressed by equation (1)

$$i_o = gm\,(v_p - v_m) \qquad (1)$$

Where gm is the transconductance, v_p and v_m are positive and negative input terminals respectively. Cascode amplifier configuration improves gain due to high output resistance and bandwidth due to reduced Miller capacitance. The ideal OTA has infinite output resistance. All of i_o flows in the external capacitive load and none flows in the OTA's own output resistance .Towards increasing the OTA output resistance, the current mirrors are cascoded.

III. PROPOSED CASCODE OPERATIONAL TRANSCONDUCTANCE AMPLIFIERS



(a) Cascode OTA

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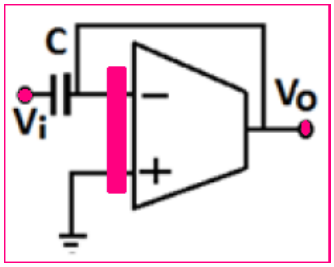
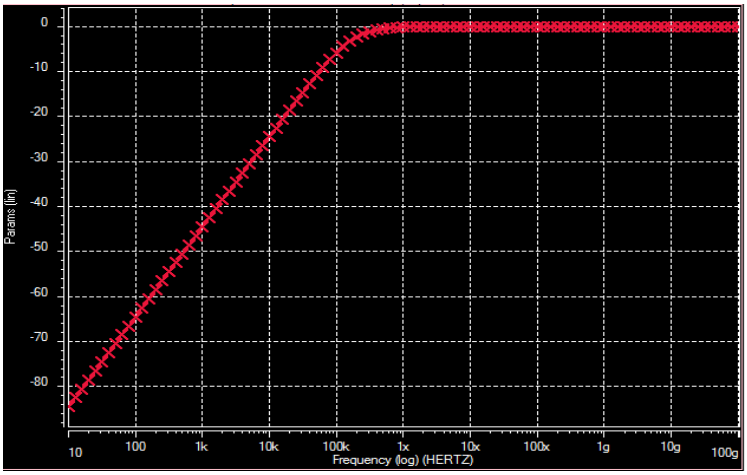
The Cascode transconductance Operational transconductance (COTA) circuit is used to design HPF at 45nm. Figure Shows the Cascode OTA and proposed HPF is simulated using 0.9 V.

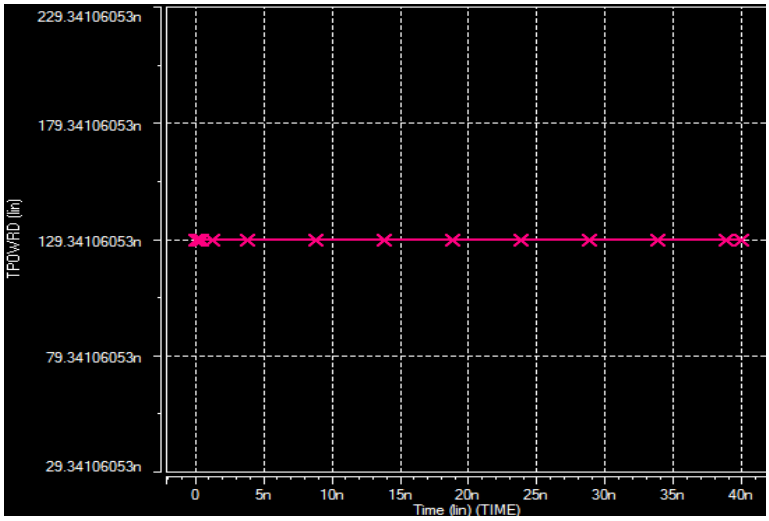


(b)Proposed High Pass Filter

Application of Cascode Operational Transconductance Amplifiers (COTAs) in High Pass Filter. Current controlled OTA are considered as basic active elements in the design of modern active filters. The active filter design using operational amplifier has a serious limitation over the applications in the high frequency regions. To overcome these limitations active filters using OTAs are popular due to the salient features of OTA such as , the adjustable transconductance (gm) over wide range of bias current , excellent matching between amplifiers, the linearity of transconductance with bias current , controlled impedance buffers and high output signal to noise ratio, which popularizes OTA in active filter design. Filters can be readily built using COTAs. Considerable flexibility in controlling those specific filter characteristics that are usually of interest is possible with COTAs . In this paper, we have implemented high pass filter.



(c)Frequency response of Proposed HPF



(d)Average Power of Proposed HPF

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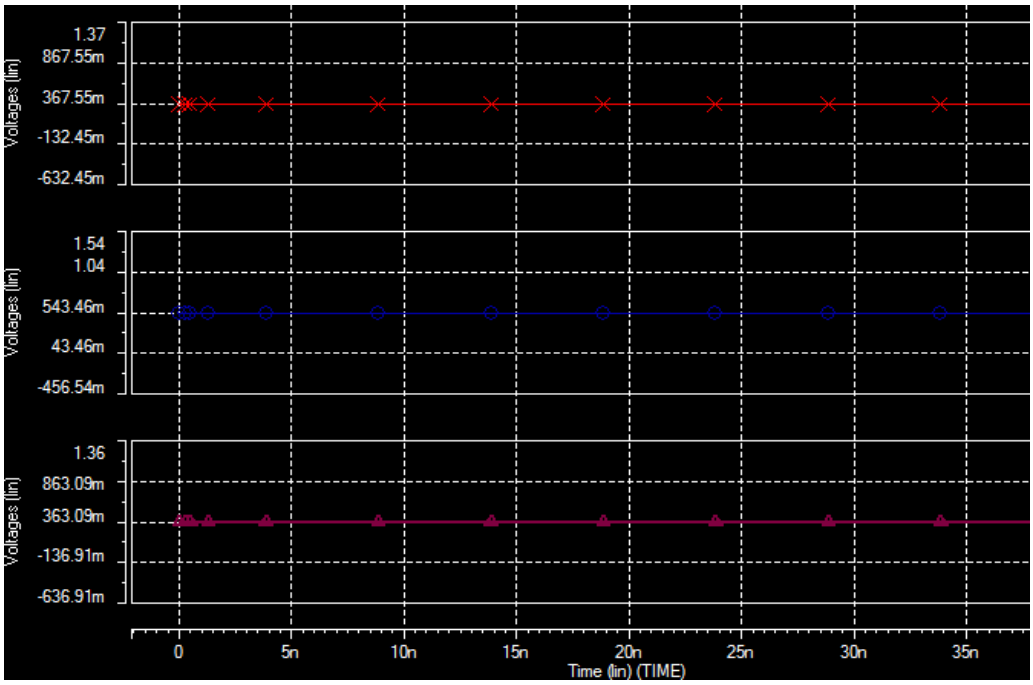

(e)Biasing Supply used in Proposed HPF

V. CONCLUSION

Cascode Operational Transconductance Amplifiers (COTA) based high pass filter is designed and simulated using HSPICE at 45nm technology for analog applications at 0.9V. It has been designed and simulated using novel carbon nanotube based MOS structures and conventional MOSFETs at 45nm technology node. The proposed structure is useful for analog applications in nanoelectronic circuits. It is observed that the proposed HPF is also consuming low power.

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