Journal Homepage: -www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
ISSN NO. 2320-5407
Article DOI:10.21474/IJAR01/6872
DOI URL: http://dx.doi.org/10.21474/IJAR01/6872

RESEARCH ARTICLE

CMOS LAYOUT DESIGN FOR OTA-C BIQUAD FILTER.

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Manuscript Info

Manuscript History

Received: 07 February 2018
Final Accepted: 09 March 2018
Published: April 2018

Abstract

This paper presents concept of universal bi-quad filter using operational trans-conductance amplifier (OTA).This OTA is biased using current of 62µA with supply voltage ±2v. TANNER environment with UMC 0.18µm technology file is used for simulation and design of this filter. This paper presents layout of an electronically tunable voltage mode universal bi-quadratic filter with three input and single output using two single ended OTA and two capacitors. The proposed filter provides low-pass, High-pass and Band-pass response by appropriately connecting the input terminals. The result of the 2nd order active bi-quad filter schematic is then compared with the layout drawn on Tanner EDA tool.

Introduction:-

Several active devices have been used to realize tunable active filters such as OTA, OP-AMP etc. OTA is widely used to realize linear and non-linear analog signal processing circuits as it provides an electronic tenability, a wide range of transconductance gain and simple circuitry. Furthermore, OTA is highly suitable for IC implementation as the circuit require no resistors. This paper presents design of a multiple input-single output (MISO) based filter.

Since multiple input based filter may lead to reduction in the number of active elements used, hence these types of filters are more suitable for IC implementation and also reduces the power consumption and area of chip design. The employment of two stage OTA in the filter provides a much better response as compared to the filter that employs single stage OTA. By appropriately connecting the input terminals, the proposed circuit can work as low pass, band pass and high pass filter without changing the circuit topology. Additionally, the natural frequency and quality factor can be controlled electronically. TANNER TOOL based simulations are performed to conform the theoretical analysis.

Proposed circuit:-

The circuit symbol of an ideal OTA is as shown in figure 1 with corresponding schematic as drawn in S- EDIT as shown in figure 2.

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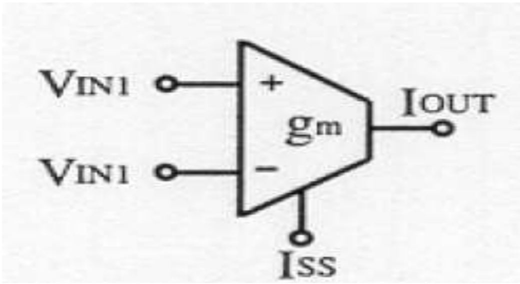


Figure 1:-Circuit symbol of an ideal OTA

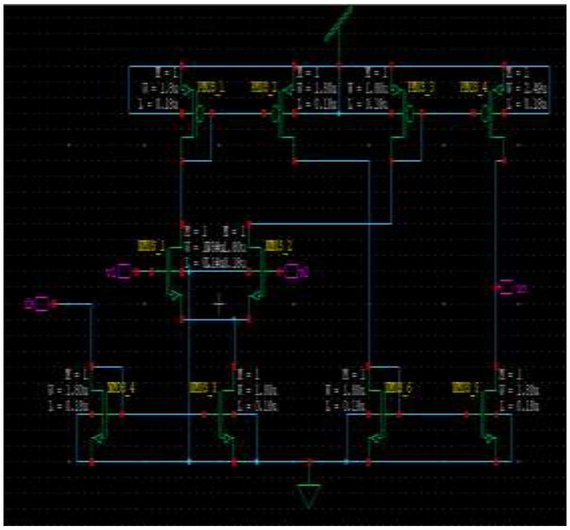


Figure 2:-Schematic of a two stage OTA

The circuit symbol of a biquad filter is as shown in figure 3 with corresponding schematic as drawn in S- EDIT as shown in figure 4.

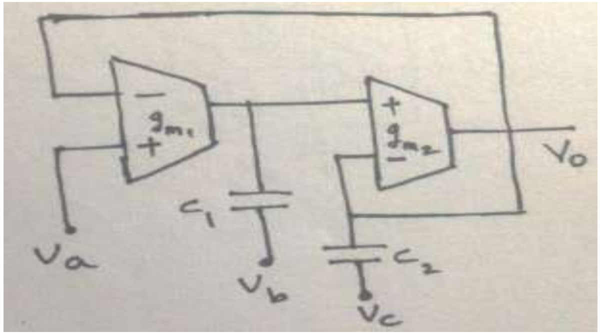


Figure 3:-Circuit symbol of a biquad filter

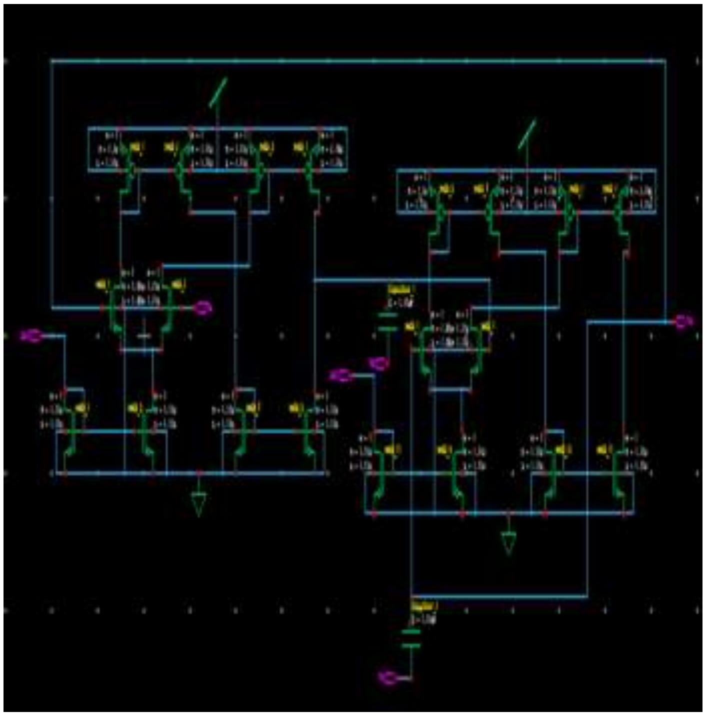


Figure 4:-Schematic of a biquad filter

Layout design:-

The layout design of the two stage CMOS OTA is shown in figure 5 and that of the biquad filter is shown in figure 6.

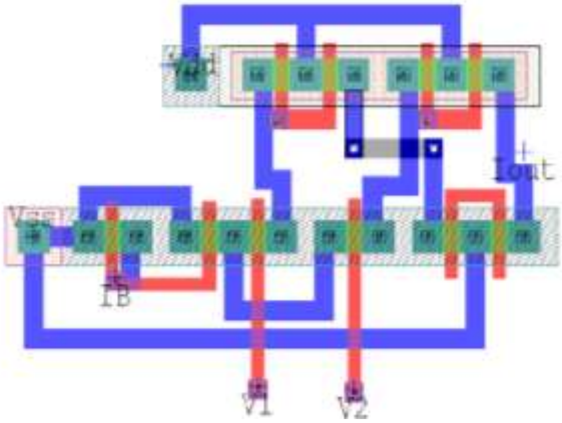


Figure 5:-Layout design of a two stage CMOS OTA

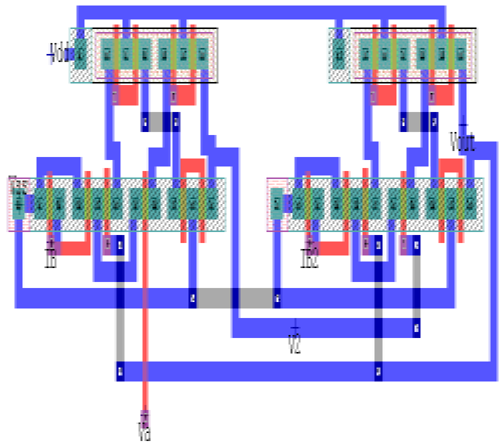


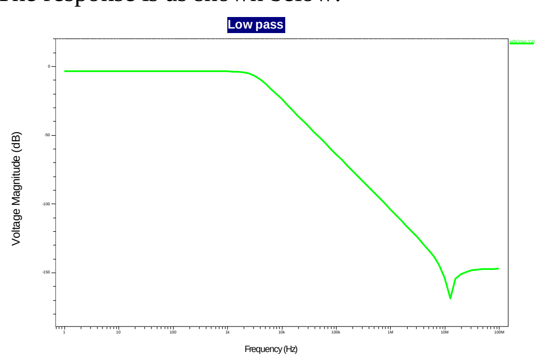
Figure 6:-Layout design of a biquad filter

The three inputs are Va, Vb below C1 and ground (C1 is below V2) and Vc below C2 and ground (C2 is below Vout).

Simulation results:-
To show the performance of the proposed circuit TANNER simulators are used. The power supplies are selected as VDD= -Vss=2V. The parameters C1= C2= 0.01uf, Ib=62µA (gm=62.7 uS) are given. The simulated result for LP, HP and BP filter characteristics are shown in figures below.
The transfer function of low pass filter is:

$$\frac{w_o^2}{s^2 + s(w_o/Q) + w_o^2}$$

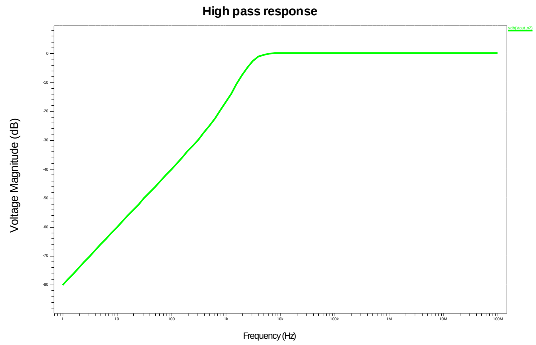
The response is as shown below:



The transfer function of high pass filter is:

$$\frac{s^2}{s^2 + s(w_o/Q) + w_o^2}$$

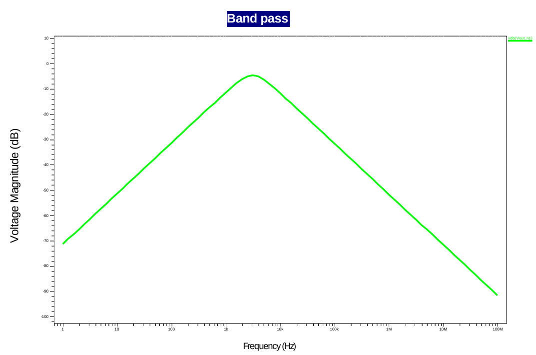
The response is as shown below:



The transfer function of band pass filter is:

$$\frac{s(w_o/Q)}{s^2 + s(w_o/Q) + w_o^2}$$

The response is as shown below:



The given biquad filter consist of three inputs Va, Vb and Vc and one output Vout.
The performance of all the three filters can be obtained by applying different combination of input on the biquad filter as shown below:

1. For low-pass filter Va=Vin, Vb=Vc=0
2. For High-pass filter Vc=Vin,Va=Vb=0
3. For Band-pass filter Vb=Vin,Va=Vc=0

Where Vin is a sinusoidal signal with frequency 1000Hz.

Conclusion;-

The results of SPICE simulation for the biquad filter are shown in agreement with the results calculated by use of design equations and methodology. Biquad filter designed, has frequency of 1 KHz. The transconductance of both the OTAs are equal to 62.7uS. The physical mask layout of any circuit to be manufactured using a particular process must confirm to a set of geometric constraints or rules, which are generally called layout design rules. The results of the simulation of layout are nearly same as that shown by the schematic of the filter.

References:-

1. R.L. Geiger and E. Sánchez-Sinencio, "Active Filter Design Using Operational Transconductance Amplifiers: A Tutorial," IEEE Circuits and Devices Magazine, Vol. 1, pp.20-32, March 1985.
2. Rahul kumar, D. S. Ajnar, P. K. Jain, ―Design of Biquad Universal Filter Using Operational Transconductance Amplifier in 180nm Technology‖, Int. Journal of Engineering Research and Applications.
3. Sun,Y. and Fidler,J.K., ―Novel OTA-C realization of biquadratic transfer functions‖, Int. J. Electronics, vol. 75, pp.333-340, 1993.
4. E. Sanchez-Sinencio and J. Silva, ―CMOS transconductance amplifiers, architectures and active filters: A tutorial, ‖ Proc. IEE Circuits Devices Syst. vol. 147, no. 1, pp. 3 – 12, 2000.