

LOW POWER CONSUMPTION CMOS DESIGN

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ABSTRACT

It has many applications in sensor interfaces and biomedical signal processing units. Biomedical signals are usually of 10-mHz to 100-Hz frequency range. The performance of filters designed by the use of passive components degrades at audio frequencies and the required resistances and inductances values calculated from the mathematical expression are very difficult to meet from the market. To find a solution to this problem is a study to realize Passive Filters into Active Filters using Operational Transconductance.

Index Terms sensors, filter, OTA, power consumption.

I. INTRODUCTION

An electrical filter is "filter-out" unwanted signals and an ideal filter will separate and pass sinusoidal input signals based upon their frequency. Filters are networks that process signals in a frequency-dependent manner. The basic concept of a filter can be explained by examining the frequency dependent nature of the impedance of capacitors and inductance.[3]It have many practical applications. A simple, single pole, low-pass filter (the integrator) is often used to stabilize amplifiers by rolling off the gain at higher frequencies where excessive phase shift may cause oscillations.[5] A simple, single pole, high pass filter can be used to block DC offset in high gain amplifiers or single supply circuits. Filters can be used to separate signals, passing those of interest and unwanted frequencies.

II. TYPES OF FILTER

FILTERS CAN BE DIVIDED INTO TWO DISTINCT WAYS:

- A. Active filters
- B. Passive filters.

Active filters contain amplifying devices to increase signal strength while passive do not contain amplifying devices to strengthen the signal. As there are two passive components within passive filter design the output signal has smaller amplitude. [2] In low frequency applications (up to 100kHz), passive filters are usually made from simple RC (Resistor-Capacitor) contain amplifying devices to strengthen the signal. As there are two passive components networks while higher frequency filters (above 100kHz) are usually made from RLC (Resistor-Inductor-Capacitor) components.[1] Passive filters are made up of passive components such as resistors, capacitors and inductors and have no amplifying elements (transistors, op-amps, etc) so

have no signal gain, therefore their output level is always less than the input. Based on frequency of signals they allow to pass through them, filters can be divided into following categories.

A. Low Pass Filter:

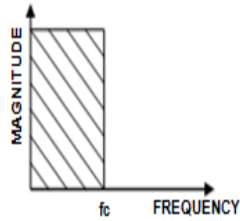


Fig 1.1 Low pass filter

There are Low-pass filters that allow only low frequency signals to pass where f_c is cut off frequency.

B. High-Pass Filters:

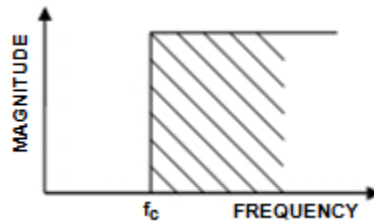


Fig 1.2 High pass filter

High-pass filters that allow only high frequency signals to pass through.

C. Band-Pass Filters

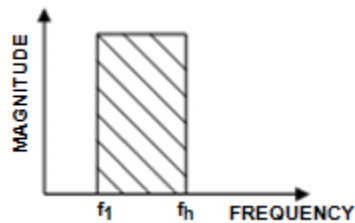


Fig 1.3 Band pass filter

D. Band Reject Filter:

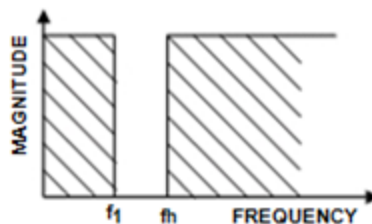


Fig 1.4 Band reject filter

A complement to the band pass filter is the band reject, or notch filter. Here, the pass bands include frequencies below f_l (lower cut-off frequency) and above f_h (upper cut-off frequency). The band from f_l to f_h is in the stop-band.

It allow signals falling within a certain frequency range to pass through. If a high-pass transfer function can be realized using a Cauer 1-form. The k th element is given by: filter and a low-pass filter are cascaded, a band pass filter is created. The band pass filter passes a band of frequencies between a lower cut-off frequency, f_l , and an upper cut-off frequency, f_h . Frequencies below f_l and above f_h are in the stop-band.

III. FILTER PARAMETERS

The idealized filter unfortunately, cannot be easily built. The transition from pass band to stop-band will not be instantaneous, but instead there will be a transition region. Stop band attenuation will not be infinite.

IV. FILTER TOPOLOGIES

Two main topologies are available to implement a linear analog filter.

A. CAUER TOPOLOGY

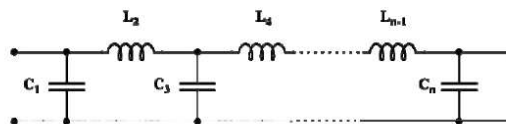


Fig 1.6 Cauer Topology

The Cauer topology uses passive components (shunt capacitors and series inductors) to implement a linear analog filter.

B. SALLEN-KEY TOPOLOGY

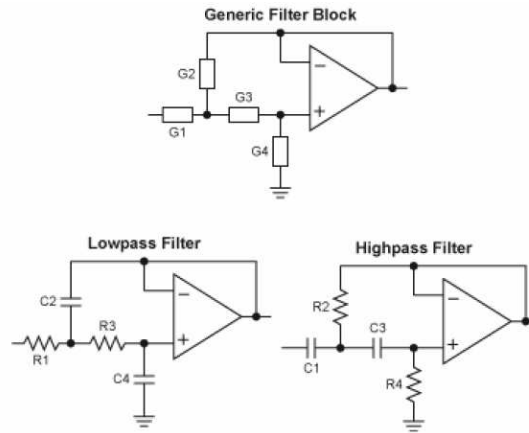


Fig 1.7 Sallen Key Topology

The Sallen-Key topology uses active and passive components (operational amplifiers, resistors and capacitors) to implement a linear analog filter.

V. OTA BASED LOW-PASS FILTERS

The conventional operational amplifier (op-amp) is used as the active device in the vast majority of the active filter literature. A host of practical filter designs have evolved following this approach.[4] It has also become apparent, however, that operational amplifier limitations preclude the use of these filters at high frequencies, attempts to integrate these filters have been unsuccessful (with the exception of a few no demanding applications), and convenient voltage or current control schemes for externally adjusting the filter characteristics do not exist.[6] In this case basic first, second and higher-order structures using the transconductance amplifier .

VI. OTA MODEL

The transconductance gain, gm, is assumed proportional to Ib. The proportionality constant h is dependent upon temperature, device geometry, and the process.

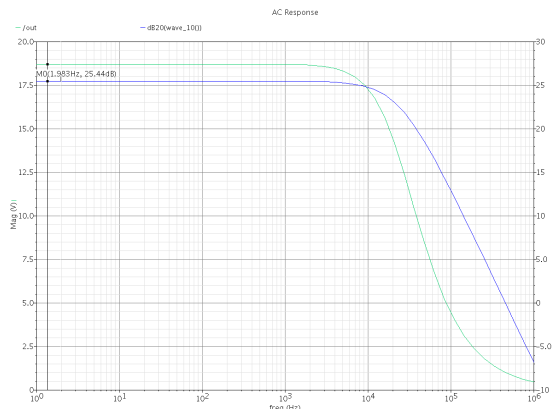


Fig 1.8 Gain plot of basic OTA structure

This OTA is designed for $5\mu\text{W}$ and 25 dB with 1.8 V power supply in $0.18\mu\text{m}$ UMC technology.[10] Then following characteristic has been obtained shown in Fig where Obtained Gain is 25.44dB and power consumed is $4.88\mu\text{W}$ of above differential OTA.

VII. BALANCED DIFFERENTIAL OTA

In a balanced OTA there are three current mirrors and a single output. The complexity of differential OTA structures is also provide an improvement in offset reduction and robustness, but not necessarily with an improvement for high-frequency applications. Thus trade-offs between speed and accuracy should be established for each particular application.

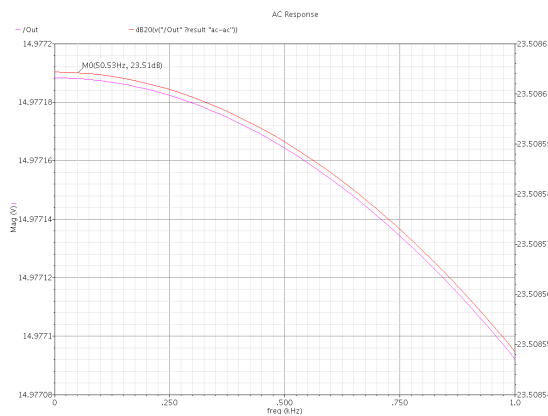


Fig 1.9 Gain characteristic of balanced OTA

VIII. APPLICATIONS

A. Typical data acquisition system for Signal is shown in fig. The preamplifier must amplify the input signal to a higher level with low distortion and low noise.

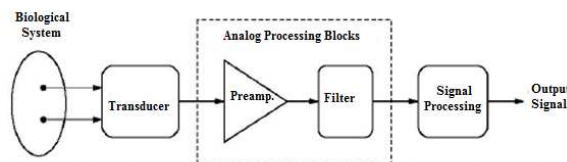


Fig1.10 Block diagram of a general purpose bioelectric signal acquisition system

- B. Filters have many practical applications. A simple, single pole, low-pass filter (the integrator) is often used to stabilize amplifiers by rolling off the gain at higher frequencies where excessive phase shift may cause oscillations.
- C. A simple, single pole, high-pass filter can be used to block DC offset in high gain amplifiers or single supply circuits. Filters can be used to separate signals, passing those of interest, and attenuating the unwanted frequencies.
- D. In integrated wireless receivers.
- E. The electrical activity within living organisms,.
- F. Butterworth low pass filter for aerospace extreme environment applications is implemented in SiGe BiCMOS technology.
- G. COGNITIVE radio

CONCLUSION

There is a great demand of low frequency low pass filter in biomedical and sensor technology at the same time low power consumption is great challenge.[9]The device designed collects cardiac data and monitors hearth and circulation activity. It is built into the human body. The device is therefore must be realized as an integrated circuit. A very low frequency low-pass filter for power ranges of nW has been designed .

FUTURE SCOPE

This work can be extended to designing of low pass filter with low frequency and low power in the future. However, the basic need in order to design low pass filter for low power is to minimize the power of OTA.

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