VDTA-Gm 회로의 CMOS 구현 및 필터 응용

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CMOS Realization of VDTA-Gm and its Application on Filter Circuits

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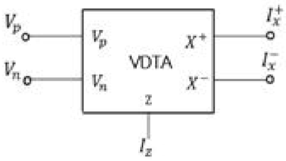
Abstract – CMOS realization of VDTA (Voltage Differencing Transconductance Amplifier) – Gm and its application in the design of multifunctional filter is presented. Small signal analysis is also done to simplify and depict the realization method. Also the parameters and can be tuned by adjusting the circuit components. The performance of VDTA-Gm amplifier and the designed Band Pass filter are simulated using HSPICE with CMOS 0.18 μm process parameters.

1. Introduction

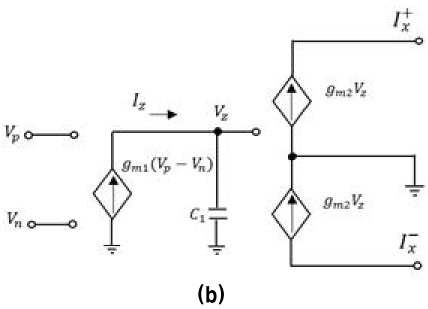
VDTA-Gm is a block structure consisting three transconductances which is actually a voltage-mode OTA circuit. This method was useful in reducing not only passive elements but also active elements, especially in designing active inductors [1-4]. However, its construction and simulation was done in ideal basis only.

In this paper, the VDTA-Gm is realized using MOSIS CMOS 0.18 μm SPICE datasheet process parameters. Natural angular frequency (ω_0) and the quality factor (Q) of the filter could be tuned electronically. Chapter 2 presents basic structure and CMOS implementation of VDTA-Gm architecture, Chapter 3 presents the design of a Band Pass filter using such circuit structure and Chapter 4 presents observations made while simulating the filter using VDTA-gm in HSPICE.

2. Structure of VDTA-Gm



(a)



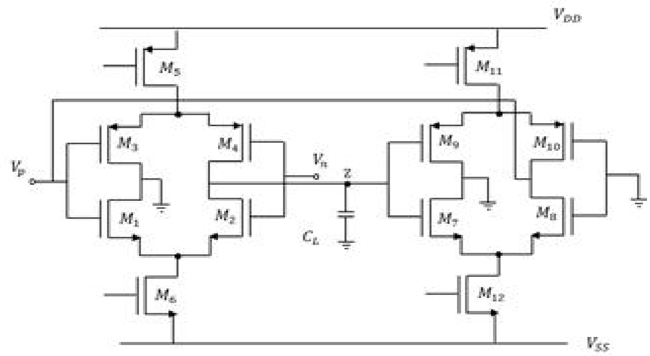
(b)

<Fig. 1> (a) Block diagram of VDTA and (b) Small signal analysis of VDTA

Fig.1(a) represents the block diagram of VDTA and Fig.1(b) represents small signal analysis of the VDTA.

$$I_z = g_{m1}(V_p - V_n)$$
$$I_x^+ = g_{m2}V_z$$
$$I_x^- = -g_{m2}V_z \quad (1)$$

Currents I_z, I_x^+ and I_x^- are derived from analyzing the small signal equivalent circuit of VDTA from Fig.1 (b).

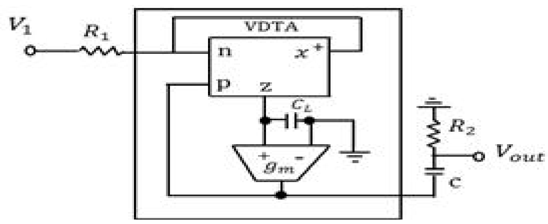


<Fig. 2> CMOS implementation of VDTA

Fig.3 represents CMOS implementation of an individual block which is a voltage controlled current source by infinite input and output impedances. It uses only four MOS transistors and one current source.

3. Design of a Band Pass Filter

A 2 MHz second order Band Pass filter is designed using VDTA-Gm.



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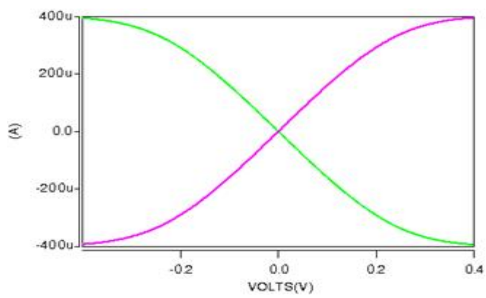

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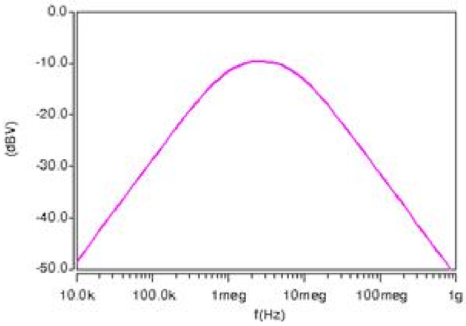

(c)

<Fig. 3> (a) Band Pass filter using VDTA-Gm, (b) I/V characteristics of gm and (c) Band Pass Filter with 2 MHz center frequency

3. Conclusion

In this paper, CMOS implementation of voltage differencing transconductance amplifier (VDTA) with an additional transconductance () has been presented. Due the design architecture and characteristics of VDTA-Gm it is suitable for low voltage and high frequency filter applications. The designed also showed high linear current voltage (I/V) characteristics. Corner frequency () and the factor of the filters could be tuned with transconductance values.

[References]

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