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Design of Operational Transconductance Amplifier for Biquad Filter Applications in 0.18µm Technology

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Abstract- This paper presents design concept of Operational Transconductance Amplifier (OTA). The 0.18µm CMOS process is used for design and simulation of this OTA. This OTA having a biasing current of 15.6 µA with supply voltage ±1.25 V. The design and simulation of this OTA is done using CADENCE Spectre environment with UMC 0.18 µm technology file. The simulation results of this OTA shows that the open loop gain of about 81.7 dB with UGB of 27.107 MHz. This OTA is having CMRR of 90 dB and PSRR of 106.07 dB. This OTA having Power dissipation of 62 uW and Slew Rate 2.44 V/µsec.

Keywords- OTA, Cadence, CMRR, PSRR, Power Dissipation, CMOS IC Design.

I. INTRODUCTION

Due to recent development in VLSI technology, the size of transistors decreases and power supply also decreases. The OTA is a basic building block in most of analog circuits with linear input-output characteristics. The OTA is widely used in analog circuits such as Neural networks, Instrumentation amplifier, ADC and Filter circuits. The Operational Transconductance Amplifier (OTA) is basically similar to conventional Operational Amplifiers in which both having Differential inputs. The basic difference between OTA and conventional Operational Amplifier is that in OTA, the output is in form of current but in conventional Op-Amps, output is in form of Voltage.

This paper is organized as follows. Section II describes brief description about operational Transconductance Amplifier (OTA) design. Section IV describes simulated characteristics of OTA. Section VI describes the conclusion of this paper.

II. OPERATIONAL TRANSCONDUCTANCE AMPLIFIER (OTA) DESIGN

Figure1 shows the schematic of Operational Transconductance Amplifier (OTA). In this OTA the supply voltage is VDD= +1.25V and VSS= -1.25V.The input AC signal is 7.49mV, 10GHz. The OTA is characterized by various parameters like Gain at dc (A_V),Unity gain bandwidth(UGB),Input common mode range (Vin (min) and Vin (max)),Load capacitance (C_L).The design parameters of this OTA are shown in below table I.

There are several different OTA's are used in which this OTA is a simple OTA with low supply voltage and high gain. The Op-amp is characterized by various parameters like open loop gain, Bandwidth, Slew Rate, Noise and etc. The performance Measures are fixed Due to Design parameters such as Transistors size, Bias current and etc. In this paper we describe design of OTA amplifier and this design is done in 0.18µm technology.

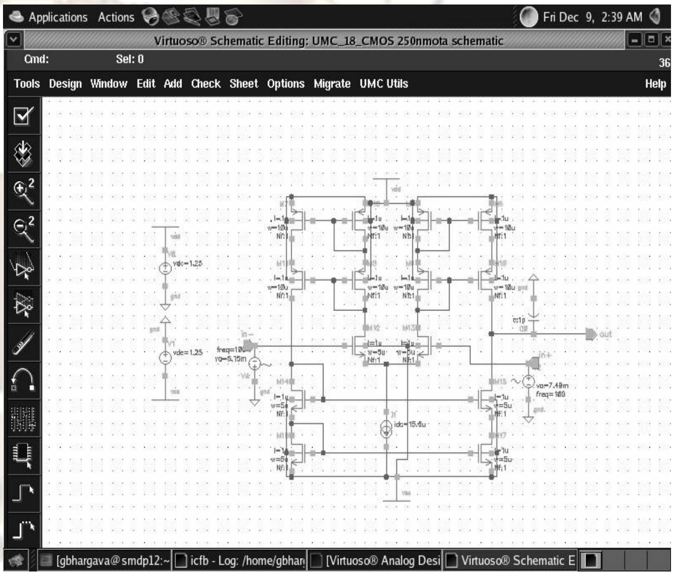

Figure 1: Operational Transconductance Amplifier.

TABLE I

TRANSISTOR SIZE

DEVICE	W/L(um)
PMOS Transistors	10/01
NMOS Transistors	05/01

III. SIMULATION RESULTS

The design of this Operational Transconductance Amplifier (OTA) is done using Cadence Tool. The Simulation results are done using Cadence Spectre Environment using UMC 0.18 µm CMOS technology. The simulation result of the OTA shows that the open loop gain of approximately 81.7 dB. The OTA has GBW of about 27.107 MHz. .
The Table II shows that the simulated results of the OTA. The AC response which shows gain and phase change with frequency is shown in figure 2. Figure 3 shows schematic for PSRR analysis of OTA. The change in PSRR with frequency is shown in figure 4. Figure 5 shows schematic for CMRR analysis. The variation in CMRR is shown in figure 6. Figure 7 shows slew rate analysis of OTA.
The simulated results of this OTA shows that PSRR of 106.07 dB and CMRR of 90 dB.

TABLE II

Specifications	Values
CMOS technology	0.18 µm
Open loop gain	81.7 dB
Supply voltage	±1.25 V
Load capacitance	1.0 pF
PSRR	106.07 dB
CMRR	90 dB
Power Dissipation	62 uW
Slew Rate	2.44 V/usec
Gain Margin	14.94 dB
Phase Margin	48.49°
Unity Gain BW	27.107 MHz

IV. SIMULATED CHARACTERSTICS OF OTA

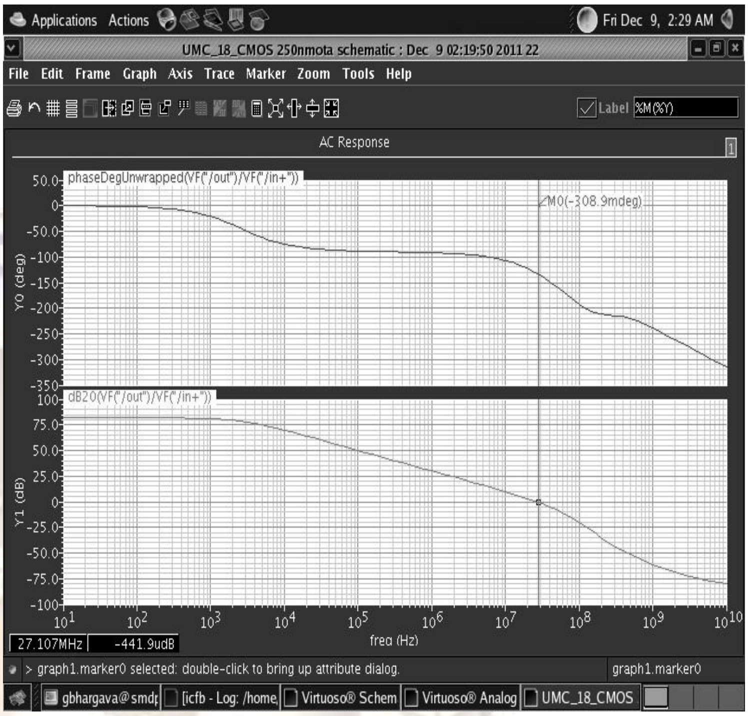

Figure 2: AC response showing gain and phase change with frequency

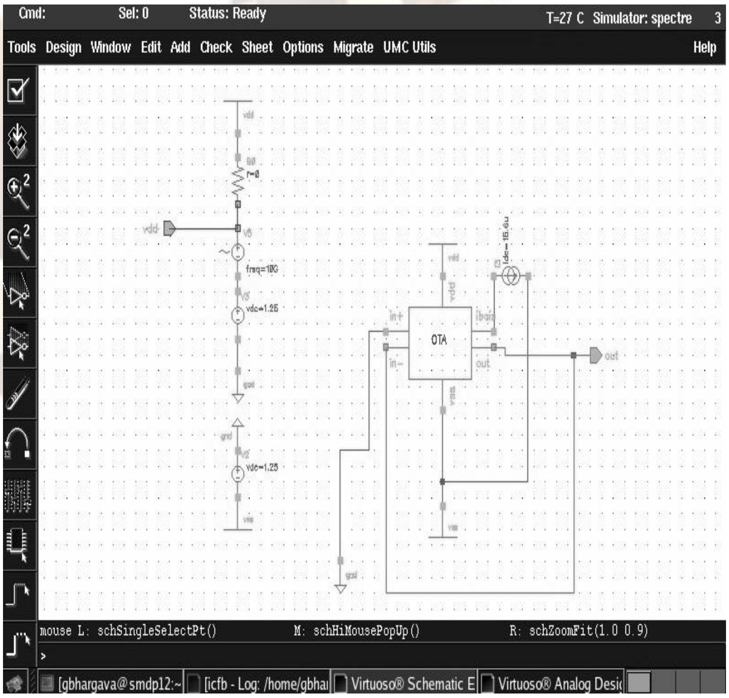

Figure 3: Schematic for PSRR

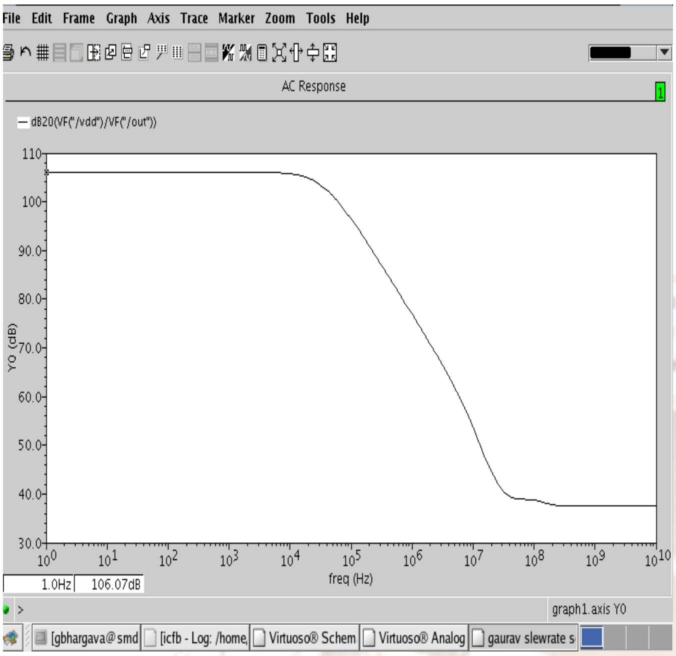

Figure 4: Change in PSRR with frequency.

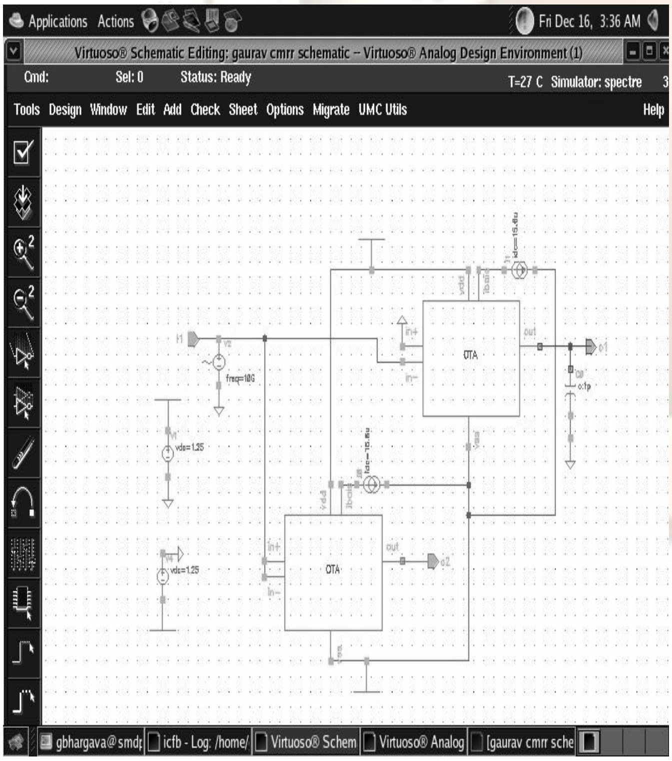

Figure 5: Schematic for CMRR

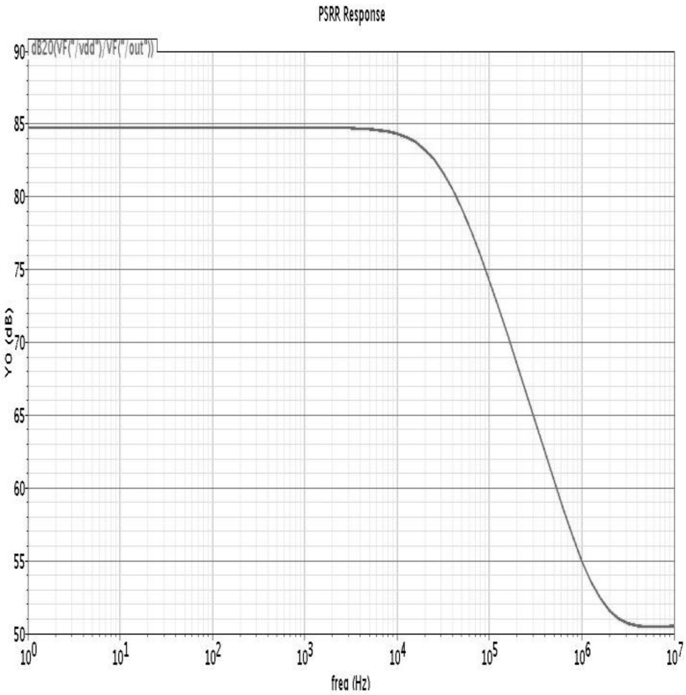

Figure 6: Change in CMRR with frequency.

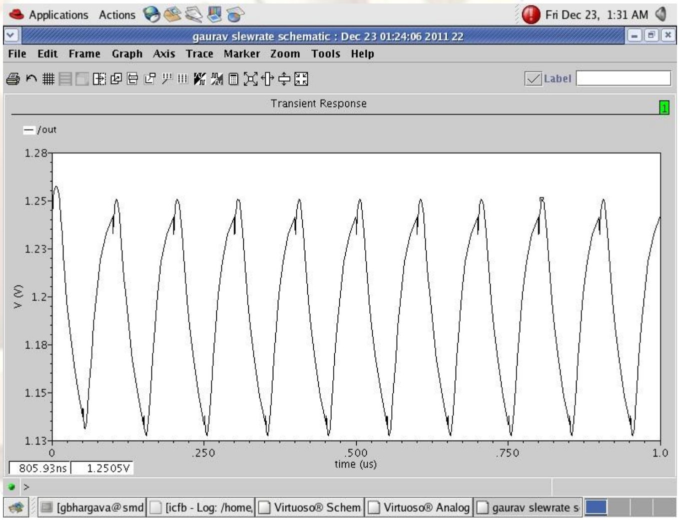

Figure 7: Slew Rate analysis of OTA

VI. CONCLUSION

In this paper we present a simple Operational Transconductance Amplifier (OTA) topology for low voltage and low power applications. This OTA can be used in low power, low voltage and high time constant applications such process controller, physical transducers and small battery operated devices. This work can be used in biquad filter design, ADC design and instrumentation amplifiers because of its high gain, high CMRR and low power consumption.

VII. REFERENCES

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