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Design of Operational Trans conductance Amplifier in 0.18µm Technology

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[#1, 2, 3,4] Micro Electronics and VLSI design

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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 bias voltage 1.8 with supply voltage 1.8 V. The design and Simulation of this OTA is done using CADENCE Spectere environment with UMC 0.18µm technology file. The Simulation results of this OTA shows that the open loop gain of about 71 dB which having GBW of 37 KHz. This OTA is having CMRR of 90 dB and PSRR of 85 dB. This OTA having power dissipation of 10 mW and Slew Rate 2.344 V/µsec.

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

1. 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 analogue circuit with linear input-output characteristics. The OTA is widely used in analogue circuit such as neural networks, Instrumentation amplifier, ADC and Filter circuit. 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 Simulation Results of OTA. Section IV describes the conclusion of this paper.

2. OPERATIONAL TRANSCONDUCTANCE AMPLIFIER (OTA) DESIGN

Figure 1 shows the schematic diagram of Operational Transconductance Amplifier (OTA). In this OTA the supply voltage is VDD= 1.8V. In the below circuit of OTA the Transistors, M11_1 and M11 work as a constant current source and Transistors M1, M2 and M3 works as two current mirror 'pairs'. The Transistors M4, M5, M6 and M7 are the Differential amplifier. The Transistor M8 is an output amplifier stage. 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 Voltage and etc. In this paper we describe design of OTA amplifier and this design is done in 0.18µm technology.

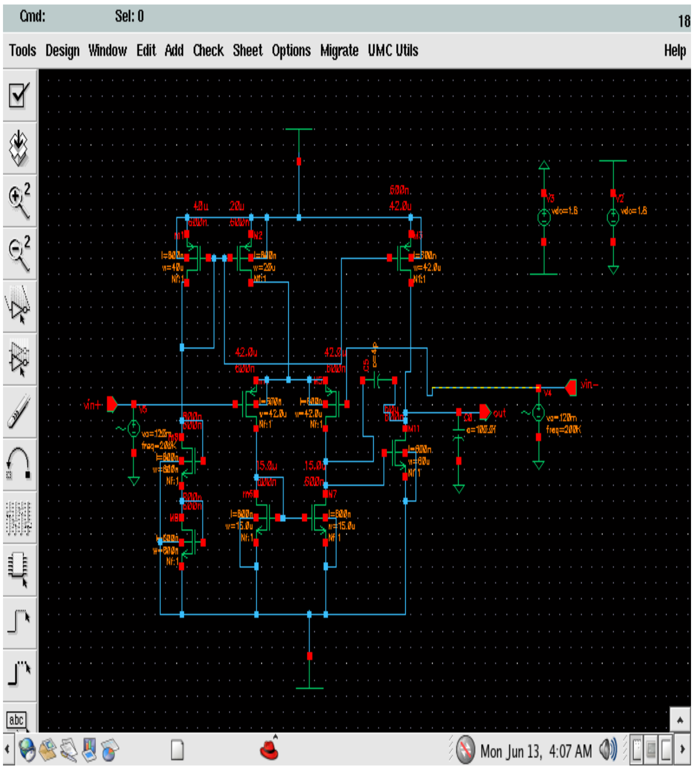

Figure 1: Operational Tran conductance Amplifier

TABLE I
TRANSISTOR SIZE

Device	W/L(µm)
M1,M2,M3	40/0.6
M4,M5	20/0.6
M6,M7,M8,M9	42/0.6
M8,M9	50/0.6
M10,M11	60/0.6
M12,M13	0.8/0.6

3. 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 71 dB. The OTA has GBW of about 37 KHz.

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 the DC sweep response of This OTA. The Transient response with input in pulse is shown in figure 4. Figure 5 illustrates PSRR variations with frequency. The variation in CMRR is shown in figure 6.

The simulated results of this OTA shows that PSRR of 85 dB and CMRR of 90 dB.

TABLE II
SIMULATED CHARACTERSTICS OF OTA

Specifications	Simulated
CMOS technology	0.18µm
Open loop gain	71 dB
Supply voltage	1.8 V
Bias Voltage	1.8V
PSRR	85 dB
CMRR	90 dB

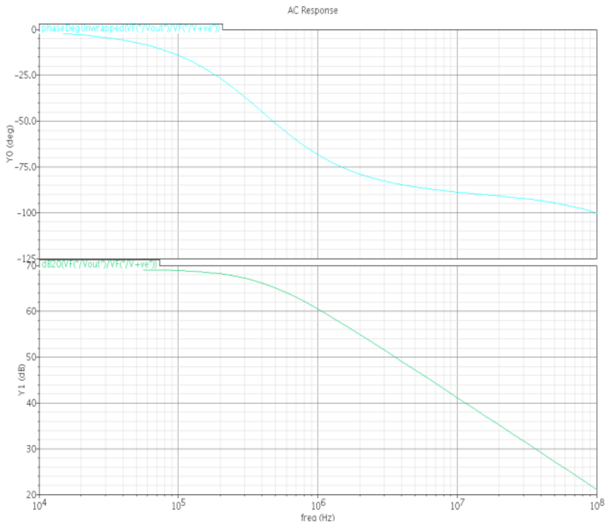

Figure 2: Shows AC response which shows gain and phase change with frequency.

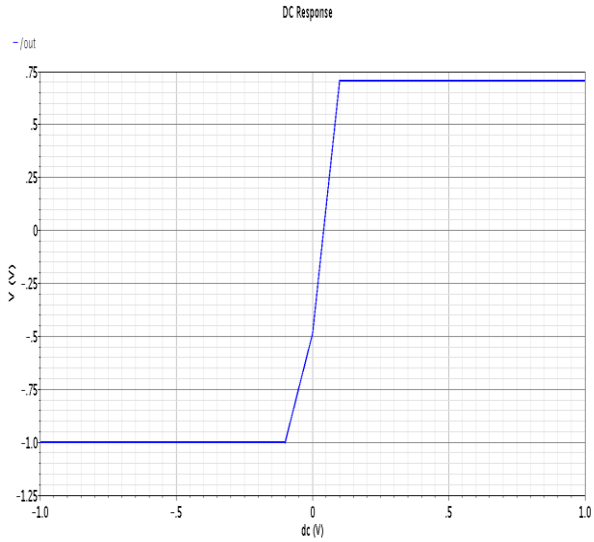

Figure 3: DC sweep response.

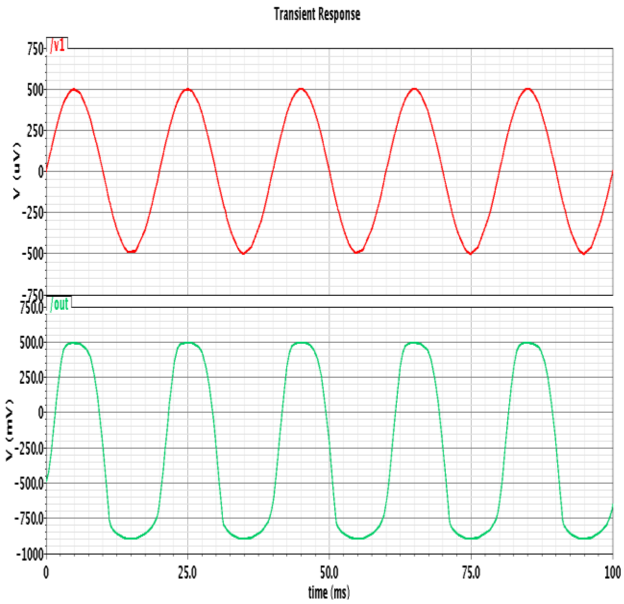

Figure 4: Transient response with input is pulse.

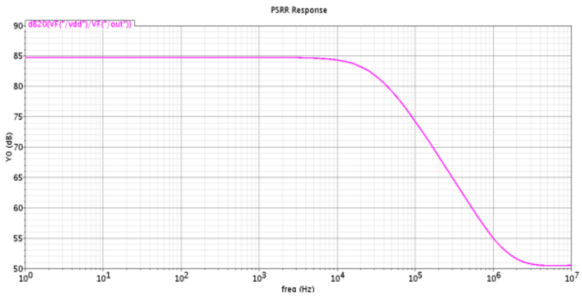

Figure 5: PSRR change with frequency.

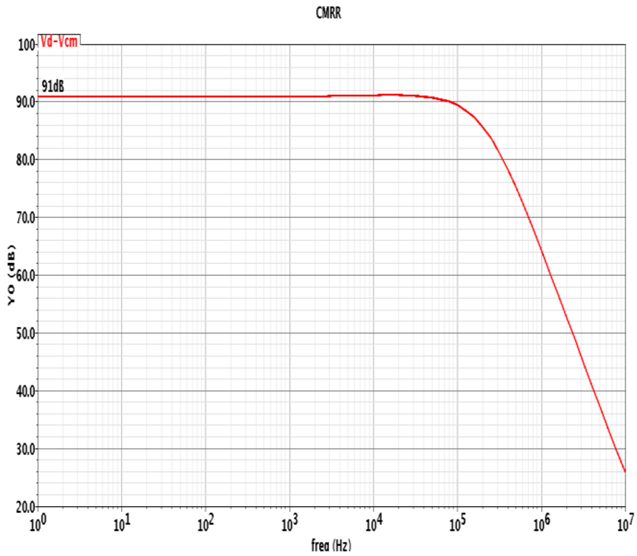

Figure 6: Change in CMRR with frequency

4. 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 filter design, ADC design and instrumentation amplifiers because of its high gain, high CMRR and low power consumption.

5. REFERENCES

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