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Comparitive Analysis of Two stage Operational Amplifier

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Abstract —*Operational-Amplifier is the key element in analog and mixed signal system They are employed from dc bias applications to high speed amplifiers and filters. General purpose op amps can be used as buffers, summers, integrators, differentiators, comparators, negative impedance converters, and many other applications. As rapid growth of Portable devices increases, it require High Speed and low power Consumption. Speed and accuracy are two most important properties of analog circuits. However optimizing circuit for both aspect leads to Contradictory demands. So Op-Amp with High slew rate and low offset is necessary for high speed devices. Among various Op-Amp Architectures, Two Stage Op-Amp has alternative features of maintaining High Gain with low Power Consumption and High Speed. The Goal of this Thesis is to design High Slew Rate and Low Offset CMOS Op-Amp.*

Keywords*-Resistor, MOSFET, slew rate, offset, analog and mixed siganl*

INTRODUCTION

An Operational Amplifier is a high-gain direct-coupled amplifier that is normally used in feedback connections. If the amplifier characteristics are satisfactory, the transfer function of the amplifier with feedback can often be controlled primarily by the stable and well-known values of passive feedback elements. The term Operational Amplifier evolved from original applications in analog computation where these circuits were used to perform various mathematical operations such as summation and integration. Because of the performance and economic advantages of available units, present applications extend far beyond the original ones, and modern operational amplifiers are used as general purpose analog data-processing elements. High-quality operational amplifiers' were available in the early 1950s. These amplifiers were generally committed to use with analog computers and were not used with the flexibility of modern units.

These amplifiers are called "Operation" Amplifiers because they were initially designed as an effective device for performing arithmetic operations in an analog circuit. The Op-Amp has many other applications in signal processing, measurement, and instrumentation.

Two Stage Op-Amp

A typical circuit configuration of an un buffered Two-Stage Op-Amp (including the Input Differential Amplifier and the Second Gain Circuit) is shown in Fig. 4.1. Transistors M_1, M_2, M_3, and M_4 form the first stage of the Op-Amp—the differential amplifier with differential to single ended transformation. In this stage, the conversion from differential to single ended is achieved by using a current mirror (M_3 and M_4). The current from M_1 is mirrored by M_3 and M_4 and subtracted from the current from M_2. The differential current from M_1 and M_2 multiplied by the output resistance of the first stage gives the single-ended output voltage, which constitutes the input of the second gain stage. The second stage is a current sink load inverter. M_6 is the driver while M_7 acts as the load. Capacitor Cc is used to lower the gain at high frequencies and provide the compensation for the Op-Amp. The first stage and the second stage circuits use the same reference current; hence, the bias currents in the two stages are controlled together [1]

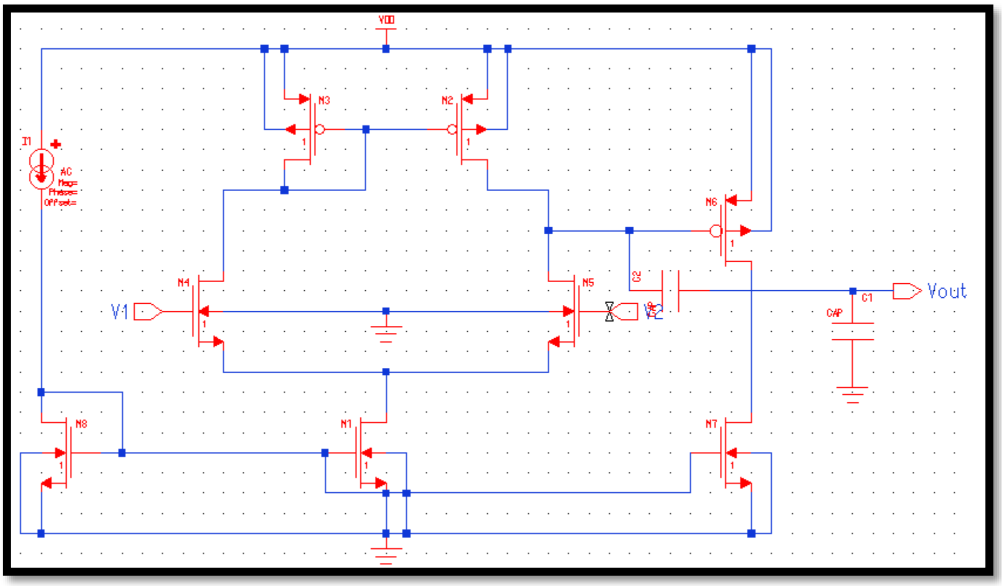

Figure 1. Two Stage CMOS Op-Amp

2.1 Simulation Results:

Here the simulation results of Two stage Op-Amp in 180nm Technology:

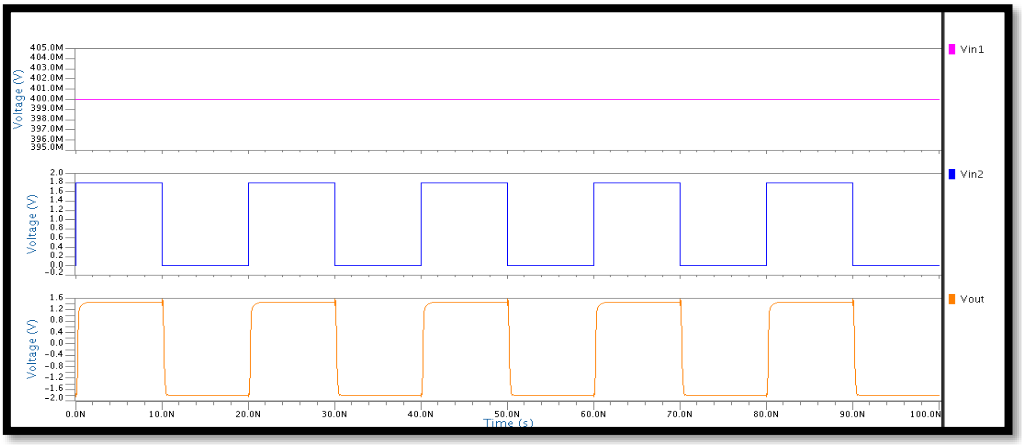

***Figure 2.* Transient Analysis**

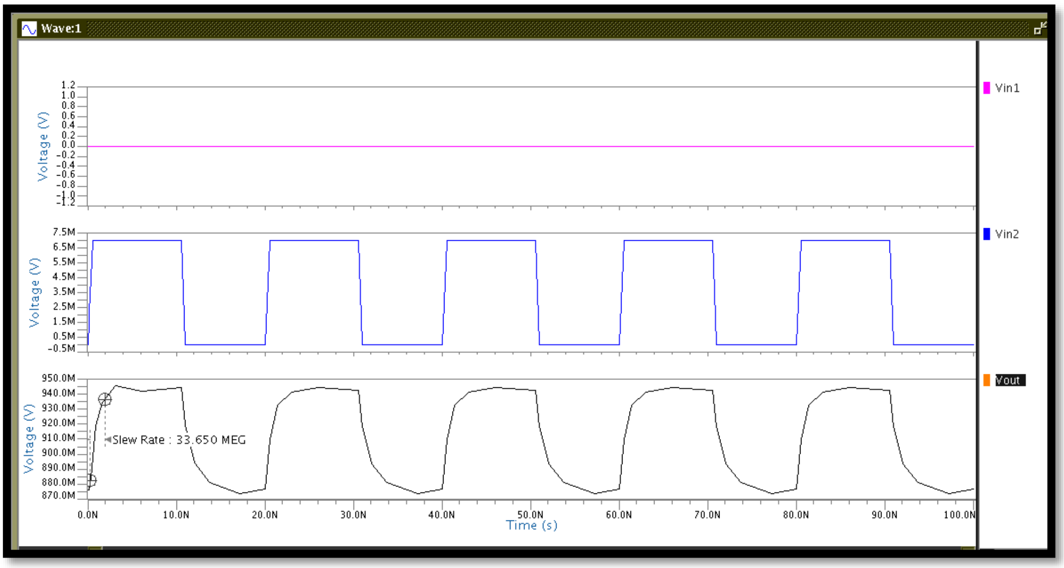

Figure 3. **Slew Rate**

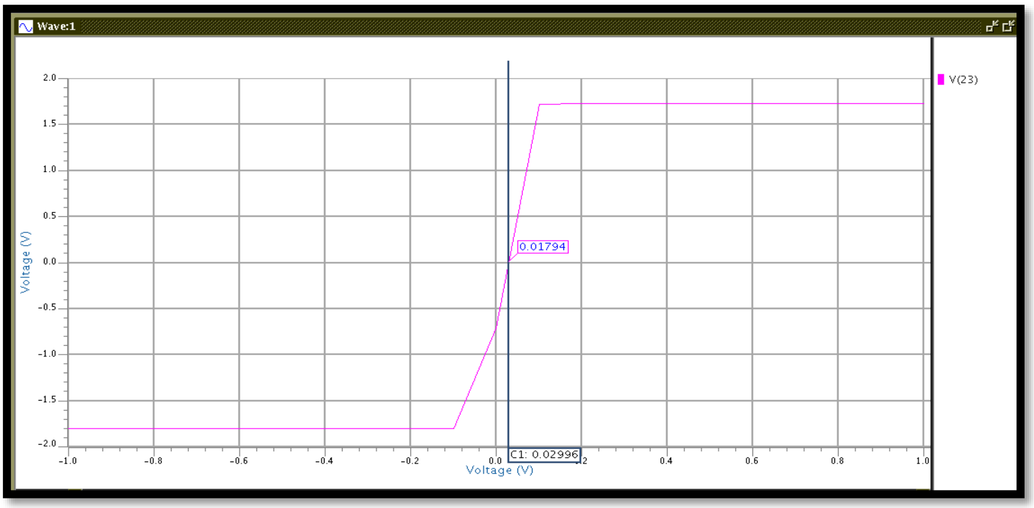

Figure 4. **Offset**

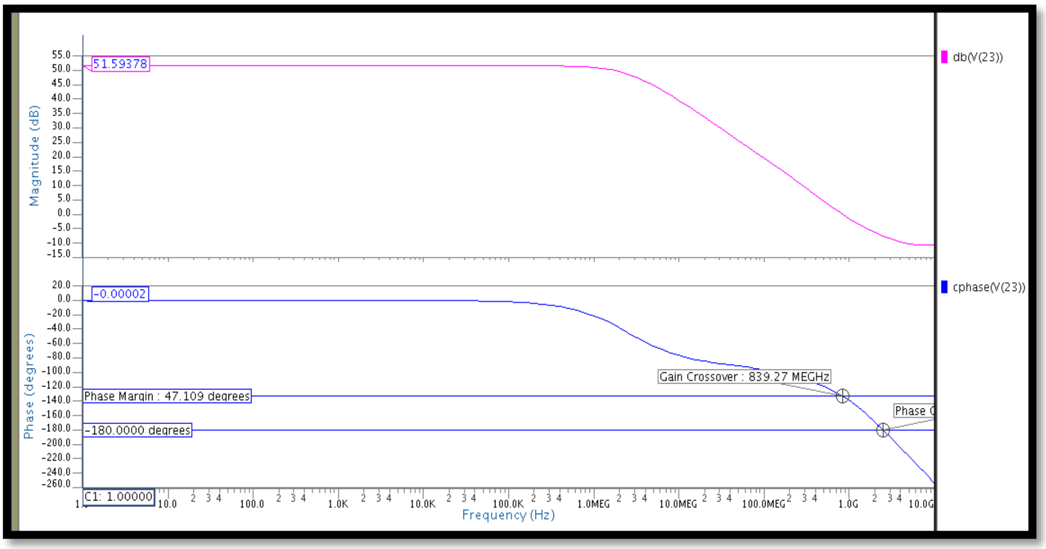

Figure 5. **Frequency Response**

Simulation Results in 90nm technology:

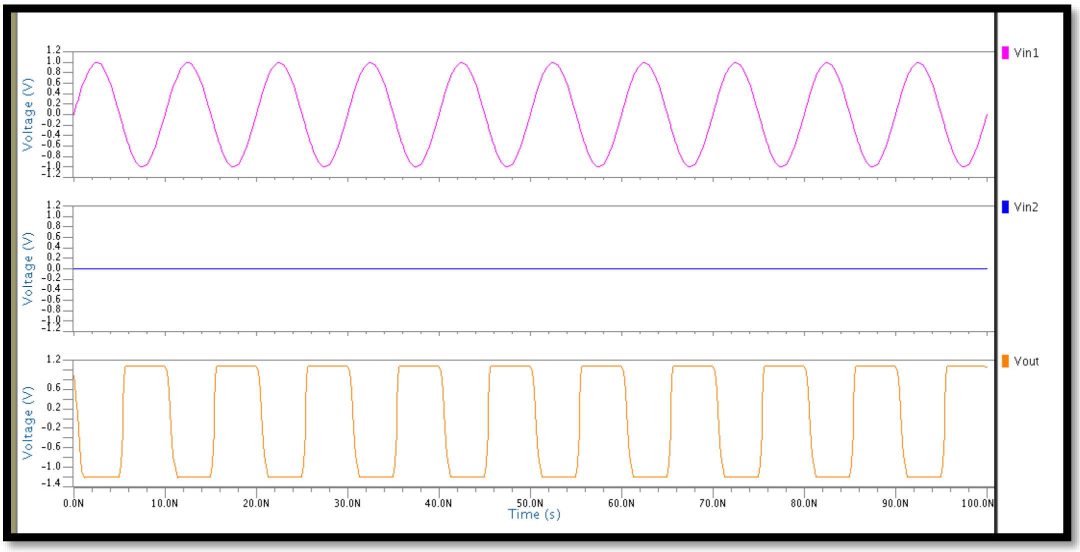

***Figure 6.* Transient Analysis**

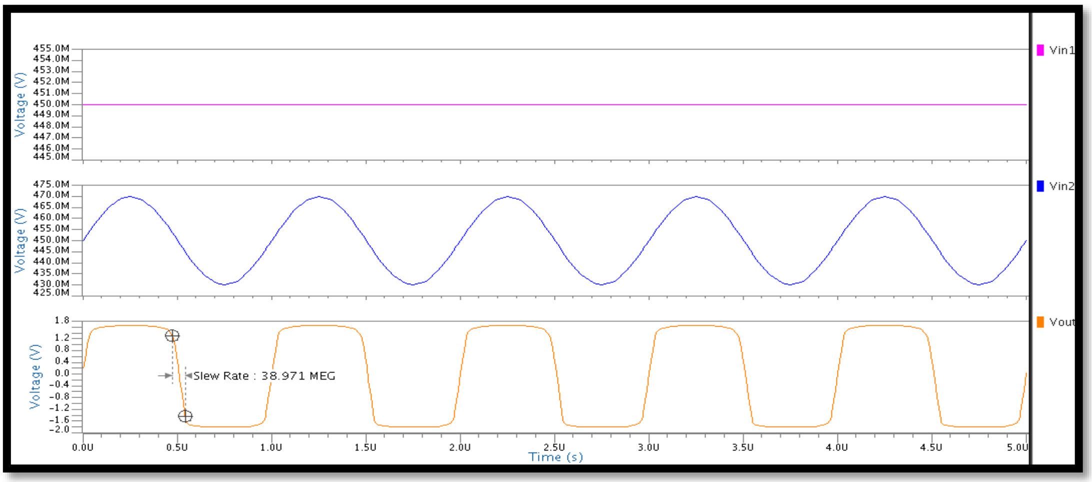

***Figure 7.* Slew Rate**

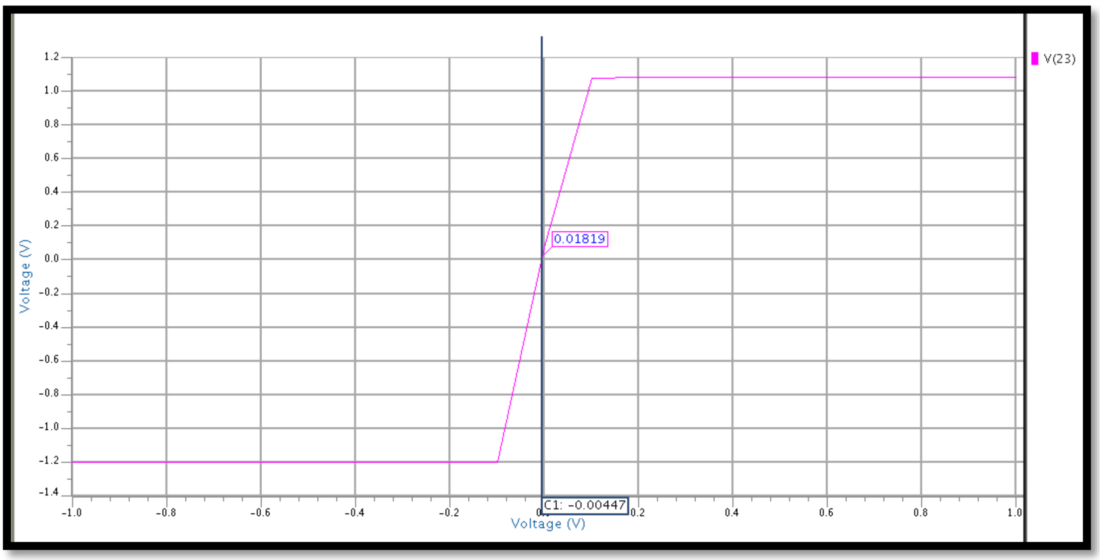

***Figure 8.* Offset**

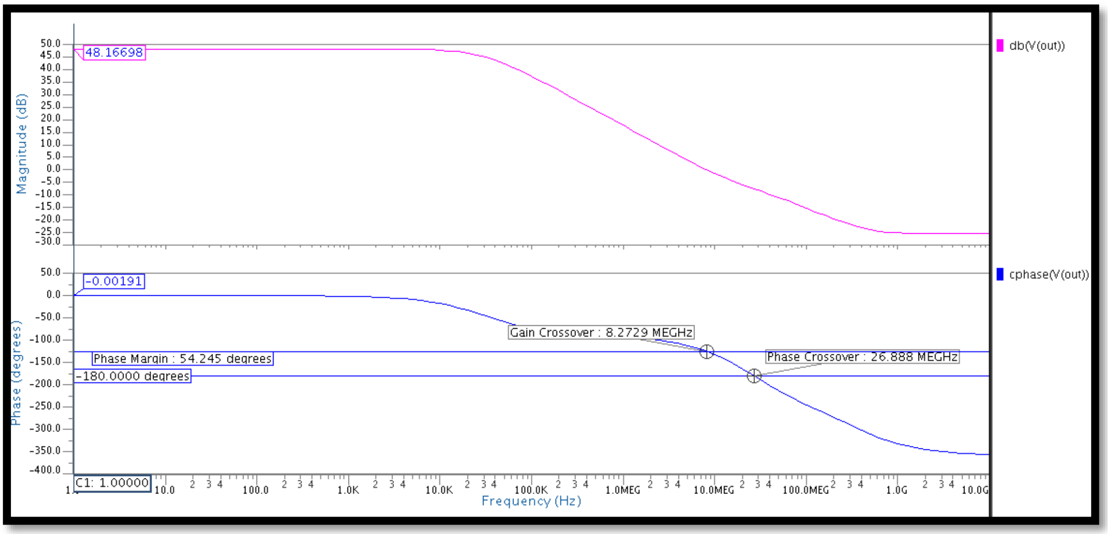

Figure 9. **Frequency Response**

Table 1. Comparative Analysis of Simulation Results

Parameter	180nm	90nm
Gain	51.59dB	47.109dB
Phase Margin	47.109^o	47.109^o
Offset	17mV	18mV
Slew-Rate	33.650V/µs	38.971 V/µs
Power Dissipation	2.97mW	1.3mW

CONCLUSION:

Simulation results for the Op-Amp is presented in this paper is 90nm and 180nm technology .All results are simulated using mentor graphic tool. From the table slew rate in 90nm technology is higher than the 180nm technology.

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