

Single Stage Operational Amplifier Using CMOS

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Abstract

Amplifiers are implemented in both digital and analog systems. An amplifier is an electronic device that amplifies the voltage, power or current of a signal. The amount of amplification done by an amplifier is measured by its gain. They are used for variety of reasons such as to amplify weak signals for further processing, to reduce effect of noise of next stage and many. CMOS Operational Amplifier is type of Differential Amplifier which provides an output from amplifier in response to differential inputs, differential input voltage cancels the common mode input voltage and it only amplifies the differential input signal. Op-amps are used to model the basic mathematical operations of addition, subtraction etc.

2 Implemented Circuit

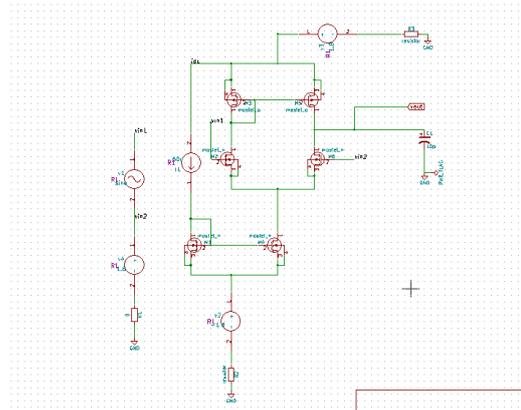


Figure 1: Implemented circuit diagram.

1 Circuit Details

to design a CMOS single stage op-amp there is a need to consider following specifications. 1.It should produce an output signal with high gain (in db) 2.And also operational bandwidth for circuit with respect to gain(Gain Bandwidth product). 3.High Slew rate that is how fast output changes with respect to input. 4.Input Common Mode Range(ICMR) the range of common mode signal for which the amplifier's operation remains linear. 5.Common Mode Rejection Ratio(CMRR) is the ratio of the differential voltage amplification to the common-mode voltage amplification. ideally the ratio is infinite. —> Designed single stage op-amp have following design specifications 1.Process specifications(V(Threshold),K' etc.) 2.Load Capacitance of 3E-19 3.differential Gain of 40db 4.Gain bandwidth 80000 Hz 5.Slew Rate greater than equal to 5 V/usec 6.ICMR (+) of 1.6v and ICMR(-) of 0.8v 7.CMRR 80db 7.Process using 130nm —> From circuit 1.Current mirrors are used in design process 2.All mosfets are working in saturation mode 3.dc current from current source is found using slew rate. 4.dimensions i.e w/l ratios of mosfets m3 and m5 are same and are found using ICMR(+) 5.dimensions of mosfets m2 and m6 are same and found using Gain Bandwidth 6.dimension of mosfet m1 is found using ICMR(-) 7. all w/l ratios, w and l are found, L should be less than twice of 130nm and in all ratios w is greater than L.

3 Implemented Waveforms

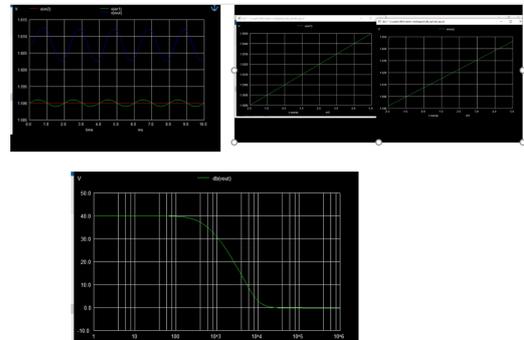


Figure 2: Implemented waveform.

References

- [1] P. D. D. D. of Electronics and A. U. Communication Engineering TSSOT. Design of cmos operational amplifiers. <https://www.slideshare.net/nandivashishth/design-of-cmos-operational-amplifiers-using-cadence>, B. Razavi, Design of Analog CMOS Integrated Circuits.