ON THE POWER EFFICIENCY OF CASCODE COMPENSATION OVER MILLER COMPENSATION IN TWO-STAGE OPERATIONAL AMPLIFIERS

HAMED AMINZADEH* and REZA LOTFI
Integrated Systems Laboratory, EE Department, Ferdowsi University of Mashhad, Azadi Square, Mashhad, Khorasan, I. R. Iran
*haminzadeh@ieee.org

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Optimization of power consumption is one of the main design challenges in today’s low-power high-speed analog integrated circuits. In this paper, two popular techniques to stabilize two-stage operational amplifiers, namely, Miller and cascode compensations are compared from power efficiency point of view. To accomplish this, cascode-compensated topologies are basically analyzed to derive the required equations for the comparison. In the analysis, a new method to take into account the effect of transfer function zeros is proposed. By assuming that the zeros’ magnitudes are fairly nondominant, the method increases the accuracy of the analyses. The relationships show that for the same specifications, cascode compensation is more power-efficient than Miller compensation, especially for heavy capacitive loads. This has been confirmed by SPICE simulations.

Keywords: Frequency compensation; low-power design; operational amplifiers; stability.

1. Introduction

Power consumption is one of the main challenging issues in modern electronic equipments. Its reduction looks like to be more challenging when designing low-voltage analog integrated circuits in deep sub-micron technologies, especially operational amplifiers (opamps). At the first glance, reduction of supply voltages and transistor dimensions seems to be effective in lowering opamp power consumption. However, as there will be less room for the signal, to keep the same signal-to-noise ratio the power should be increased. Moreover, as lower available power supplies prevent the designers to stack adequate transistors upon each other, it becomes quite difficult to satisfy both the required DC gain and voltage swing with single-stage amplifiers. As a result, multistage opamps with more power-hungry branches might be inevitable.¹

Two-stage opamps are used widely in industry to achieve high DC gain and high output voltage swing together. To avoid instability in the negative feedback loop, the opamp frequency response should be appropriately compensated. Several