

An Ultralow-Power Low-Voltage Fully Differential Opamp for Long-Life Autonomous Portable Equipment

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Abstract:- This brief presents an ultralow-power class-AB operational amplifier (OpAmp) designed in a low-cost 0.18- μm CMOS technology. The proposed circuit uses transistors biased in the sub-threshold region for low-voltage low-power operation. For 40.8-V single supply, this OpAmp has 51-dB open-loop gain, 57-kHz unity-gain frequency, 60° phase margin, and 65-dB common-mode rejection ratio for 8-pF loads with a power consumption of only 1.2 μW . Experimental results illustrate performances such as 0.14-V/ μs slew rate and a 750-mV linear output swing, demonstrating its correct functionality.

Keywords:- CMOS analog integrated circuits, low-power design, operational amplifiers (OpAmps).

I. INTRODUCTION

The growing demand for long-life autonomous Portable equipment is driving the current trend toward Low-power design. Nevertheless, the systems need to have very long-time battery lifetimes since, in most Cases, it is not possible to recharge or replace batteries frequently. As a result, speed and/or dynamic range sometimes might have to be sacrificed in order to conserve energy. Analog circuits based on transistors operating in the sub-threshold region consume less energy for active operation and dissipate less leakage power than operating in the strong inversion region. In this way, the performance achieved in the sub threshold region is more than adequate for these and other energy-constrained applications.

II. OPAMP DESCRIPTION

The conceptual idea of the proposed fully differential OpAmp is shown in Fig. 1. It can be split into two main parts: The first is the core of the amplifier (in black), composed of a rail-to-rail input stage using adaptively biased complementary input pairs and a class-AB output stage; the second one (in gray) is the common-mode feed forward (CMFF) circuit. Headings, or add dashes, colons, etc. Basically, the principle of operation of this OpAmp is the following: Input signals $V^+ - V^-$ in $= V_{cm} + V_{diff}/2$ (where V_{cm} is the input common-mode voltage and V_{diff} is the differential input voltage) are converted into currents $I^+_{out} = g_m^+ \cdot V^+$ in and $I^-_{out} = g_m^- \cdot V^-$ in by means of the rail-to-rail input stage. The transconductance has two components g_d and g_c related to the differential and common-mode input voltages, respectively.

To remove the dependence of the output currents I^+_{out} and I^-_{out} on V_{cm} , a CMFF circuit, which adds to each of them the adequate extra current to cancel the common-mode component, is introduced. In addition, as it will be shown later, this CMFF circuit biases conveniently the output stage so that the dc voltage gain of the OpAmp is kept almost constant in spite of variations in the input common-mode voltage V_{cm} . Next, a more detailed description of each part of the OpAmp is given.

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