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A New Grounded Memristor Emulator Based on MOSFET-C

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Abstract: In this paper, memristor emulator circuit consisting of only seven MOS transistors and one grounded capacitor is presented. Memristors exhibit nonlinear voltage-current relationship and many previous emulator circuits have multiplier circuit to provide the nonlinear characteristic of the memristor. But there is no any multiplier circuit block in the proposed circuit so the proposed memristor circuit occupies low chip area. The memristor circuit is laid by using Cadence Environment with TSMC 0.18 µm process parameters and its layout dimensions are only 12 µm x 38 µm excluding the area of the capacitor. The post-layout simulation results for memristor are given to demonstrate the performance of the presented memristor emulator in different operating frequencies, process corner, and radical temperature changes. All post-layout simulations agree well with theoretical analyses. Besides the VLSI implementation of the memristor, the proposed circuit is built on the breadboard using discrete circuit elements.

Keywords: Memristor emulator, incremental memristor, MOSFET-C, layout, experimental results.

1. Introduction

To realize a device with low energy consumption and high-density memory is important for nanoscale system design. In the past few decades, Moore's Law becomes powerful in the integrated circuits industry. But building smaller transistors gives rise to more cost and more leakage currents. The memristive devices emerge as the promising alternative to the existing CMOS technology. Leon Chua postulated a new fourth passive circuit element in 1971 and 1976 [1], [2]. Chua called the new passive circuit element as 'memristor' which is a portmanteau for memory and resistor. But the new circuit element could not attract any interest by researchers and circuit designers until its physical realization by Hewlett Packard (HP) research team [3]. HP research team realized the TiO_{2-x} memristor and announced "The missing memristor found" in Nature [3]. The properties of the memristor can be outlined: It operates as a passive element such as resistor; behaves history-dependent element (namely, depends on state-variable); depends on current direction, polarized element; behaves as a frequency-