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Research Article

Low-Power Differential Voltage-Controlled Ring Oscillator Based on Carbon Nanotube Field-Effect Transistor (CNTFET)

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Abstract

Due to the better common-mode elimination of power supply voltage and sub-substrate noise, the differential ring oscillator (DRO) performs better than the single-ended ring oscillator (SERO) in both analog and digital integrated circuits. Also, it is easy to achieve high frequency performance with in-phase and quadrature outputs in a differential ring oscillator. For this purpose, in this research, the design and simulation of a three-stage differential voltage controlled circular oscillator (DVCRO) based on carbon nanotube field effect transistor (CNTFET) is presented, whose oscillation frequency can be changed by changing the control voltage of the proposed delay cell structure. A very wide range changed from 45.7 GHz to 110.18 GHz, and at the same time, its power consumption is in the range of 5.17 μ W to 32.68 μ W. Based on the results obtained at the supply voltage of 0.9 V, the proposed voltage controlled ring oscillator (VCRO) based on carbon nanotube field effect transistor shows promising characteristics compared to its counterpart based on metal-oxide-semiconductor field effect transistor (MOSFET). Also, it performs exceptionally well compared to other existing oscillators.

Keywords: Carbon Nanotube Field Effect Transistor (CNTFET), Power Delay Product (PDP), delay cell, Differential Voltage Controlled Ring Oscillator (DVCRO), Single Ended Ring Oscillator (SERO).

Highlights

- Presentation of a new 9-transistor delay cell based on carbon nanotube field effect transistor (CNTFET).
- The changeability of the delay characteristic in the proposed delay cell by changing the control voltage.
- Providing a three-stage differential Voltage Controlled Oscillator (VCO) based on carbon nanotube field effect transistor in the high frequency range and beyond.
- Achieving a wide adjustment range with low power consumption in the proposed voltage controlled oscillator.

Citation: (in Persian).