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Efficient Design of Keeper Circuit Using Wide Fan-In Gates

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Abstract: In this paper, several circuits are proposed for wide fan-in gates, where the purpose is to achieve an efficient design. The technique which is utilized in this paper is based on the replacement of Si-MOSFET by CNTFET. Dynamic logic and Static logics are examined and verified for the better performance, the proposed circuit decreases the capacitance in dynamic node and increase its performance in desired fields. The proposed model decreases the parasitic capacitance on the dynamic node, yielding a smaller keeper for wide fan-in gates to implement fast and robust circuits. Thus, the contention current and consequently power consumption and delay are reduced. The average power and power dissipation is taken as parameters. Microwind and Hspice is used to analyze the results. The replacement of Si-MOSFETs by CNTFETs yields a decrease of 39% in the average power consumption.

Key words: Dynamic logic · Parasitic Capacitance

INTRODUCTION

Silicon-based technology has experienced phenomenal growth in the last few decades. A large part of the success of the MOS transistor is due to the fact that it can be scaled in to increasingly smaller dimensions, which results in higher performance [1]. Though this trend still continues, bulk MOSFET will soon reach its limiting size. For this reason, the semiconductor industry is looking for different materials and devices to integrate with the current silicon-based technology and in the long run, possibly replace it. The carbon nanotube field effect transistor is one among the most promising alternatives due to its superior electrical properties [2-4].

The existing available field effect transistor is Si-MOSFET and it is being replaced by CNTFET [5]. This paper reviews different types of CNTFET which are one of the most promising devices to replace Si MOSFET in near future.

Therefore it is very important to have reduced size and having preferable characteristics like less delay, average power required and power dissipation etc.,

These entities are determined by using several tools such as Dschematics, microwind, Hspise.

CNTFET: Carbon nanotubes field effect transistor. Single walled carbon nanotubes (SWCNTs) have huge potential for applications in electronics because of both their metallic and semiconducting properties and their ability to carry high current [6-9]. CNTs can carry current density of the order 10 $\mu A/nm^2$, while standard metal wires have a current carrying capability of the order 10 nA/nm^2.

Semiconducting CNTs have been used to fabricate CNTFETs, which show promise due to their superior electrical characteristics over silicon based MOSFETs. Since the electron mean free path in SWCNTs can exceed 1 micrometer, long channel CNTFETs exhibit near-ballistic transport characteristics, resulting in high-speed devices. The first CNTFET was fabricated in 1998 [10-12]. In the same year R. Martel et.al. fabricated field-effect transistors based on individual single- and multi-wall carbon nanotubes and analyzed their performance. The broad classifications of CNTFET are discussed below.

Geometry Dependent CNTFET: The first back gate CNTFET was proposed by Tans et al. In this structure a single SWCNT was used to bridge two noble metal electrodes prefabricated by lithography on an oxidized silicon wafer. Here the SWCNT plays the role of channel

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