



**AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
CAIRO - EGYPT**

Design of Multi-bit Memristor Based Nano Memories

A Thesis

Submitted in partial fulfillment for the requirements of the degree of Master of
Science in Electrical Engineering

Submitted by

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B.Sc. of Electrical Engineering
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STATEMENT

This thesis is submitted to Ain Shams University in partial fulfillment of the degree of Master of Science in Electrical Engineering.

The work included in this thesis was carried out by the author in the Department of Electronics and Communications Engineering, Ain Shams University.

No part of this thesis has been submitted for a degree or a qualification at any other university or institute.

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Dedication

To my parents and my brothers, for their everlasting love and support.

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Published Papers

Hossam, H., G. Mamdouh, H. H. Hussein, M. Dessouki and H. Mostafa. "A new read circuit for Multi-bit Memristor based on Time to Digital Sensing Circuit," *IEEE International Midwest Symposium on Circuits and Systems*, Windsor, Ontario, Canada, pp. 1114-1117, 2018.

Hossam, H., M. Dessouki, and H. Mostafa, "Time-Based Read Circuit for Multi-Bit Memristor Memories", *IEEE International Conference on Modern Circuits and Systems Technologies (MOCAST'18)*, Thessaloniki, Greece, pp. 1-4, 2018.

Design of a Multi-bit Memristor Based Nano Memories.

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Abstract

Emerging non-volatile universal memory technology is vital for providing the huge storage capabilities required by the new era. The recently found memristor "the missing fourth circuit element", is a potential candidate for the next-generation memories and has received great attention in the last few years because of their unique properties especially in memory technologies. Owing to their analog nature, memristors have a remarkable ability to store multi-bit values in a single cell. In this work, a literature review of the current memory technology (conventional semi-conductor memories) and the non-emerging nonvolatile memories is discussed. Also, different memristor-based applications are reviewed showing that the memory application is the most promising one. Besides, to support the memristor technology specifically or generally RRAM technology, a new Read/Write circuit for multi-bit memristor memories is discussed and compared with the other proposed Read/Write circuits in the literature. The proposed circuit exhibits lower power consumption, less delay when compared to recently published Read/Write circuits. Moreover a comparative study on the capability of different memristor models for transient multilevel memristive memory simulation is discussed and proposed a window function that can improve the accuracy of models based on filament growth theory.

key words: memristor, multi-bit memory, read circuit, time based ADC