Novel Memristor-based Wireless Communications Blocks

By

Nahla Elazab AbdEllatif Elashker

A Thesis Submitted to the

Faculty of Engineering at Cairo University

In Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

In

Electronics and communication Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2019

Novel Memristor-based Wireless Communications Blocks

By

Nahla Elazab AbdEllatif Elashker

A Thesis Submitted to the

Faculty of Engineering at Cairo University

In Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

In

Electronics and communication Engineering

Under the Supervision of

Prof.Dr. Ahmed Hussein Khalil
Professor of Electronics and Communication Engineering
Faculty of Engineering, Cairo University

Prof.Dr.Hossam Fahmy
Professor of Electronics and Communication Engineering
Faculty of Engineering, Cairo University

Assoc. Prof. Dr. Mohamed Mostafa Abodina
Associate Professor of Electronics and Communication Engineering
Faculty of Engineering, Cairo University

Dr.Ghada Hamdy Ibrahim
Researcher of Electronics and Communication Engineering,
Electronic Research Institute

Faculty of Engineering, Cairo University
Giza, Egypt
2019

Novel Memristor-based Wireless Communications Blocks

By

Nahla Elazab AbdEllatif Elashker

A Thesis Submitted to the

Faculty of Engineering at Cairo University

In Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

In

Electronics and communication Engineering

Approved by the Examining Committee:

Prof. Dr. **Ahmed Hussein Khalil**, Thesis Main Advisor

Assoc. Prof. Dr. **Hassan Mostafa**, Internal Examiner

Prof. Dr. **EL-Sayed Mostafa Saad**, External Examiner,
Faculty of Engineering, Helwan University

Faculty of Engineering, Cairo University
Giza, Egypt
2019

Engineer: Nahla Elazab AbdEllatif Elashker

Date of Birth : 1 / 3 / 1982
Nationality : Egyptian
E-mail : nahlaelazab@yahoo.com
Phone. : 0111457229
Address : 155 Yasmine 4, 1st settlement, New Cairo
Registration Date : 1 / 3 /2011
Awarding Date : / /
Degree : DOCTOR OF PHILOSOPHY

Department : Electronics and Electrical communication

Supervisors : Prof. Dr. Ahmed Hussein Khalil
Prof. Dr. Hossam Aly Fahmy
Dr. Mohamed Mostafa Abudina
Dr. Ghada Hamdy Ibrahim

Examiners: Prof. Dr. Ahmed Hussein Khalil
Dr. Hassan Mostafa
Prof. Dr. EL-Sayed Mostafa Saad

Title of Thesis: **Novel Memristor-based Wireless Communications Blocks**

Key Words: Memristor, Demodulator, VCO, Phase Frequency Detector, Phase Locked Loop.

Summary:

The distinction of memristor device as being non-volatile, having nanoscale dimension, and CMOS compatible makes it a real alternative to CMOS device. In this context, the main objective of this thesis is to study the dependence of the memristor resistance on the initial phase of the applied periodic signal. Based on that, a set of building blocks for communication applications are designed, i.e. BPSK, QPSK, QAM, and BFSK demodulators. Next, memristor-based sinusoidal phase frequency detector, voltage controlled oscillator, and phase locked loop are presented.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Nahla Elazab AbdEllatif Elashker Date:3/7/2019

Signature:

Dedication

This dissertation is lovingly dedicated to the spirit of my father, ***Elazab Elashkar***, who had always dreamed of completing my academic studies and to my mother, ***Aida Mohamed Othman*** for her praying to progress in my life.

Acknowledgments

First of all, I thank Almighty God for His blessings and generosity. Second, I am glad to express my deep sense of gratitude to ***Dr. Ahmed Hussein*** for his valuable guidness and co-operation in completing this research work. Also, I am greatly thankful to ***Dr. Hossam Fahmy*** for his intuitive thinking and giving me the honor to pursue my Ph.D. studies under his supervision.

Moreover, I would like to thank ***Dr. Ghada Hamdy*** to make her time to review this thesis and for keeping in touch with me in spite of her traveling. Also, I would like to thank ***Dr. Mohamed Mostafa Aboudina*** for his creative ideas and cooperation in thesis reviewing. In addition, I would like to thank ***Eng. Mohamed Badr*** for his great technical support.

Lastly, I am very thankful to my husband, ***Eng. Mohamed Sakr***, for providing me with all the technical and emotional supports to finish this thesis and to my daughters, ***Mariam and Maya***, for accepting my unintended shortening in their rights throughout my research work.

Table of Contents

List of Tables

List of Figures