

بسم الله الرحمن الرحيم





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Cairo University

DESIGN OF MM-WAVE PHASE INVARIANT VARIABLE GAIN AMPLIFIER AND LOW PHASE NOISE VOLTAGE CONTROLLED OSCILLATOR FOR 5G TRANSCEIVERS

By

Yahia Zakaria Mohamed Ibrahim

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Electronics and Communications Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
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Under the Supervision of

Prof. Ahmed N. Mohieldin

Dr. Mohamed A. Y. Abdalla

.....
Professor
Electronics and Communications
Engineering
Faculty of Engineering, Cairo University

.....
Associate Professor
Electronics and Communications
Engineering
Faculty of Engineering, Cairo University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Approved by the
Examining Committee

**Prof. Dr. Ahmed N. Mohieldin,
Dr. Mohamed A. Y. Abdalla,**

**Thesis Main Advisor
Advisor**

Prof. Dr. Islam A. Eshrah,

Internal Examiner

Prof. Dr. Mohamed A. El-Nozahi,
Associate Professor
Faculty of Engineering, Ain Shams University

External Examiner

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

Engineer: Yahia Zakaria Mohmed Ibrahim
Date of Birth: 30/9/1994
Nationality: Egyptian
E-mail: yahiazaakaria@eng.cu.edu.eg
Phone: +20 1143409109
Address: 5 Compound Ganna Elsheikh Zayed
Registration Date: 1/10/2017
Awarding Date: --/2021
Degree: Master of Science
Department: Electronics and Communications Engineering



Supervisors: Prof. Dr. Ahmed N. Mohieldin
Dr. Mohamed A. Y. Abdalla

Examiners: Prof. Dr. Ahmed N. Mohieldin (Thesis main advisor)
Dr. Mohamed A. Y. Abdalla (advisor)
Prof. Dr. Islam A. Eshrah (Internal examiner)
Dr. Mohamed A. El-Nozahi
Associate Professor
Faculty of Engineering, Ain Shams University

Title of Thesis:

Design of mm-wave phase invariant Variable Gain Amplifier and low phase noise Voltage Controlled Oscillator for 5G transceivers

Key Words:

5G transceivers – VGA – current steering – wideband – VCO

Summary:

This Thesis presents the design and implementation of two important building blocks for phased arrays used in 5G transceivers; namely Variable Gain Amplifier (VGA) and Voltage Controlled Oscillator (VCO). It proposes the design and implementation of a current steering VGA where novel techniques are adopted to achieve very low phase and gain errors across the entire gain range. The proposed current steering VGA achieves a wideband response and shows an excellent correlation between the measurements and the simulations. A Novel VGA architecture is also introduced in this thesis which is based on the concept of ac currents addition and subtraction to achieve inherently wideband phase invariant response without any trade-off with the other VGA parameters such as gain, bandwidth, linearity and noise. In addition, this thesis proposes the design and implementation of an LC cross-coupled VCO and a novel transmission line based VCO. Coarse and fine tuning are used together with a fixed capacitor technique to achieve wide tuning range for the LC based VCO. The transmission line based VCO provides a square wave at the output of the VCO with very low power consumption, this can be used in high speed digital applications. Varactor is added at the middle of the transmission line in order to add tuning to the VCO by changing the electrical length of the transmission line.

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: Yahia Zakaria Mohamed Ibrahim

Date:

Signature:

Acknowledgements

In the name of Allah the most merciful the most gracious; all thanks to Allah the Lord of the Heavens and Earth and peace be upon Mohamed and his companions. I wish to express my gratitude to my supervisors Dr. Mohamed Ahmed Youssef Abdalla and Prof. Ahmed Nader Mohieldin for their technical help. In addition, I am very grateful to Dr. Ahmed Ibrahim Khalil for giving me the opportunity to fabricate my work, for Eng. Ahmed Aboulseoud for measuring this work and for all the RF team at Analog Devices.

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