بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
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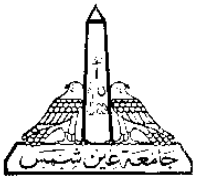

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Electronics Engineering and Electrical Communications

MILLIMETER-WAVE SILICON BASED FRONT-ENDS FOR WIRELESS COMMUNICATION

A Thesis submitted in partial fulfillment of the requirements of the degree of

Master of Science in Electrical Engineering

(Electronics Engineering and Electrical Communications)

by

Yousri Abozaid Mohamed Ahmed

Bachelor of Science in Electrical Engineering

(Electronics Engineering and Electrical Communications)

Faculty of Engineering, Ain Shams University, 2014

Supervised By

Prof. Mohamed Amin Ebrahim Dessouky

Dr. Mohamed Ahmed Mohamed El - Nozahi

Cairo - (2021)

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Examiners' Committee

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Date:29 August 2021

Statement

This thesis is submitted as a partial fulfilment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain shams University.
The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Date:29 August 2021

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Abstract

Fifth generation (5G) is the next mobile communication standard that will support higher data rates, higher spectrum efficiency, reliability, and lower latencies. Currently, demanding frequency bands for mm-wave 5G are at 24.25-27.5 GHz, 28 GHz, and 39 GHz. Building wideband beamformers/transceivers to cover the entire mm-wave 5Gfrequency bands from 24 GHz to 47 GHz is appealing for the next generation systems. Such wideband systems require the design and development of wideband or tunable components to achieve the desired performance. Those components include switches, low noise amplifiers, power amplifiers ...etc.

The thesis presented a tunable resonant multiband T/R switch designed and fabricated in 45nm SOI CMOS to cover the frequency band from 24 GHz to 47 GHz allocated for 5G. The proposed tunable switch relied on changing the number of stacked devices that are on. The proposed switch was implemented and fabricated using 45 nm SOI technology and it consumed an area of 0.05 mm2. Measurement results showed low insertion loss of minimum value of 0.8 dB with high linearity achieved in the TX path.

Also, the thesis presented a linearized low-noise amplifier (LNA) is proposed and fabricated in 45nm SOI CMOS. The LNA covers the frequency band from 32 GHz to 49 GHz. A linearization circuit is proposed to boost the Linearity IIP3. The LNA occupies an area of 0.25 mm2. The LNA achieves a gain of 18.7 dB, noise figure in the range of 2.8-3.8 dB, a peak value of IIP3 at 3.5 dBm at 38.5 GHz. The LNA consumes 15 mW from a 1.25 V supply.

Thesis Summary

The thesis is divided to five chapters as listedbelow, Chapter 1

Inthischapter,anintroductionaboutthe5Gcommunicationsystemsispresented. Finally, the organization of the thesis is briefly discussed.

Chapter 2

Chapter 2 gives a sufficient background of beamforming architectures with corresponding used blocks. Then, a prior art of the T/R switch and linearization techniques for LNA and the drawbacks of these topologies are presented. Finally, the used technology node is presented.

Chapter 3*

Chapter 3 discusses the RF T/R switches. A new proposed tunable multiband T/R switch design is proposed in order to mitigate the drawbacks and achieve wideband operation. The theory is carried to design a T/R switch operating at 24-47 GHz band using 45nm SOI CMOS technology. A comparison is performed with the state-of-the-art switches.

Chapter 4

Chapter 4 discusses the linearization of low noise amplifier (LNA). A new proposed linearized LNA design is proposed to mitigate the drawbacks. The theory is carried to design a LNA operating at 32-49 GHz band using 45nm SOI CMOS technology. A comparison is performed with the state-of-the-art LNAs.

Chapter 5

In chapter 5, the thesis is summarized where the main contributions are high-

lighted. In addition, possible future research directions are suggested.

Keywords: Millimeter-wave; Front-Ends; Wireless Communication; Satellite; 5G Mobile Communication; RF switches; Linearization; LNA.

* The proposed tunable multiband T/R switch was published in IEEE microwave and wireless components letters (2021).

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Yousri Abozaid Mohamed Ahmed

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