

**SPDT SWITCH DESIGN USING SWITCHABLE RESONATOR AT 5GHZ FOR
WIRELESS COMMUNICATIONS**

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SPDT Switch Design using Switchable Resonator at 5GHz for Wireless
Communications

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This report is submitted in partial fulfillment of the requirements for the award of the
Bachelor of Electronic Engineering (Electronic Wireless Communication) with Honors

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

June 2016



UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : SPDT SWITCH DESIGN WITH SWITCHABLE RESONATOR
AT 5GHZ FOR WIRELESS COMMUNICATIONS

Sesi Pengajian :

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Saya

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Date :

Specially.....

To beloved and supportive parents

To my kidn brother and sister

And to all my friends

For their Love, Encouragement, and Best wishes

ACKNOWLEDGEMENT

First and foremost, I would like to give thanks to ALLAH S.W.T for helping me through the entire obstacle that I encountered during the work of this project and without his blessing I will not come to achieve this.

I would like to express my sincere to my main supervisor Dr Noor Azwan bin Shairi for the continuous support for my project and thesis writing, for his patience, motivation, enthusiasm, and immense knowledge. His wide knowledge and his great way of thinking have been great value for me.his guidance helped me in all the time of research and writing of this thesis.

I wish to express my warm and since thanks to Mr Abdullah form the Master student of Faculty of Electronic and Computer Engineering, his understanding and knowledge about this project and introduce me how to use Advance Design System (ADS) software is very important toward me.

Special thanks to my beloved family for their moral support in completing this project. The same goes to my friend and others for their support and helping me during the entire final year project session. Lastly, thank you to everyone who had been to the crucial parts of realization of this project.

ABSTRACT

Single Pole Double Throw switch (SPDT) is one type of the radio frequency (RF) switch is used for time division duplex (TDD) system which it can reduce the problem between transmitting and receiving process. High isolation value between the transmitter and receiver in the RF front end system is an important parameter in the design SPDT switch, especially for high power applications. Furthermore, the insertion loss and return loss also the parameters that need to be consider in the SPDT switch design. Therefore, this project work introduced the SPDT switch design using switchable resonator to get the higher isolation, great insertion loss, and higher return loss. The microstrip resonator by using transmission line stub resonator and discrete PIN diode were selected in this SPDT switch design. The project of SPDT switch will be designed for the applications at 5GHz in wireless frequency front-end system. The example of application that operate at 5Ghz such as WiFi and WLAN. These SPDT switch projects should get the isolation value higher than 30dB to avoid any problems between the transmitter and receiver. In addition, the return loss should be more than -10dB and insertion loss should get value almost to 0

ABSTRAK

Suis Satu Kutub Dua Lontar (SPDT) dalam sistem frekuensi radio (RF) digunakan untuk komunikasi dupleks pembahagian masa (TDD) yang dapat mengurangkan masalah dalam proses penghantaran dan penerimaan. Nilai isolasi yang tinggi diantara penghantaran dan penerimaan dalam sistem RF adalah satu parameter yang penting dalam merekabentuk suis SPDT terutama dalam aplikasi kuasa tinggi. Selain itu, nilai return loss dan attenuation juga parameter yang perlu diberi kepentingan di dalam rekabentuk suis SPDT ini. Oleh itu, projek ini memperkenalkan suis SPDT yang menggunakan resonator boleh suis untuk mendapatkan isolasi yang tinggi, nilai kehilangan sisipan dan kehilangan pulangan yang baik. Resonator jalur-mikro yang menggunakan resonator punting talian penghantaran dan diod PIN telah dipilih di dalam projek suis SPDT ini. SPDT suis di dalam projek ini akan direkacipta untuk applikasi di frekuensi 5GHz untuk modern wireless front-end system. Aplikasi yang menggunakan frekuensi 5Ghz antaranya ialah WiFi and WLAN. Projek suis SPDT ini perlu mendapatkan pengeluaran isolasi lebih dari 30dB untuk mengelakkan sebarang masalah diantara proses penghantaran dan penerimaan. Selain itu, nilai return loss perlu lebih dari 10dB dan insertion loss perlu mendapat nilai hamper dengan 0.

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LIST OF ABBREVIATIONS

SPDT	-	Single Pole Double Throw
TDD	-	Time Division Duplex
RF	-	Radio Frequency
WiFi	-	Wireless Fidelity
WLAN	-	Wireless Local Area Network
FR4	-	Flame Retardant 4
FET	-	Field Effect Transistor
ADS	-	Advance Design System
UV	-	Ultra Violet
PCB	-	Printed Circuit Board
dB	-	Decibel
CMOS	-	Complementary Metal Oxide Semiconductor
DC	-	Direct Current

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CHAPTER I

INTRODUCTION

1.1 Introduction

This chapter covers the introduction of the project, background study regarding the project of SPDT switch, project objective, the problem statement involves, scope of work for this project and the methodology of this project.

1.2 Project Background

RF switch (using SPDT type) is the one type of the communication system that being use for Time Division Duplex (TDD) to minimize the problem in the transmission process. Single Pole Double Throw is commonly used in RF front-end system to switch between transmitter and receiver for data transmission. SPDT switch will be designed at 5 GHz for modern wireless front-end system using FR4 substrate. Discrete pin diodes will be used as switching elements to support transmit and receive operation and will reduce any RF power leakage in this process. The design will be developed to support modern wireless communications at 5 GHz such as WiFi and WLAN. To complete this system, there are several techniques of isolation improvements such as material with

fabrication process design, circuit design, resonant circuit, transmission line and resonator.

1.3 Project Objective

In order to complete this project, there are several objective of the project need to achieve. The specific objectives of this project are as follows:

1. To design the SPDT switch between the transmitter and receiver at 5GHz for wireless communication for WiFi or WLAN.
2. To simulate the SPDT switch using switchable resonator for wireless communication.
3. To fabricate and measure the prototype of SPDT switch for validation with simulation result

1.4 Scope of Work

The scopes of the project work are mainly focused on design the SPDT switch using switchable resonator at 5GHz for wireless communication such as WiFi and WLAN. So, this project will be designed at 5GHz for modern wireless front-end system using Pin Diode and FR4 substrate. The scope of work this project as follows:

1. Determine the suitable SPDT switch circuit for wireless communication at 5GHz.
2. Design the circuit and simulate the circuit of SPDT switch with switchable resonator.
3. Fabricate the circuit of SPDT switch and measure each of the output from the SPDT switch.
4. Test the prototype using network analyzer for S-parameter measurement.

5. Analysis and discussion for simulation and measured either the output of the project obtain isolation higher than 30dB at 5GHz.
6. Technical report writing

1.5 Problem Statement

In Time Division Duplex (TDD) communication systems such as WLAN and WiFi, there are many power leakages between the transmitter and receiver system especially for high power application. High value of isolation which more than 30dB is required between the RF front-end's transmitter and receiver to minimize any high RF power leakage that could distort active circuit in the receiver. Furthermore, for high frequency it is difficult to get isolation higher than 30 dB in the SPDT switch for wireless communication.

The value of insertion loss and return loss also need to focus to prevent the problem between transmitter and receiver in the wireless communication system. The insertion loss is usually needed almost to zero and return loss should be more than 10dB at 5GHz.

Switchable Resonator is one of the solutions to obtain isolation higher than 30 dB at 5GHz. The great isolation, insertion loss and return loss can be achieved by using switchable resonator and standard discrete PIN diode to develop SPDT switch at 5GHz for wireless communication.

1.6 Project Significance

The project significance which is to able to understand the knowledge and information about the Procedure and method to complete the SPDT switch project. The

understanding about the component and material can be achieved in the progress during this project.

Futhermore, with the SPDT switch with switchable resonator may help in reduce the power leakage between transmitter and receiver in wireless communication application such us WiFi and WLAN. SPDT with the switchable resonator is very usefull in order to have the great isolation, Insertion loss and return loss during the transmission process.

1.7 Thesis Outline

SPDT switch by using switchable resonator project is a combination of 5 chapters overall that contains and elaborates specific topics which is Introduction, Literature Review, Methodology, Result and Analysis, and Conclusion and recommendation.

Chapter 1 : Introduction of the SPDT project which the explanation about the project will be given in a general term. The objective of the project will be elaborated. It is followed by the explanation the scope of work to complete this project and also the problem statements.

Chapter 2 : Literature review for the development of SPDT switch project. This chapter describes the literature review of the current existing projects which related with the SPDT switch project. Explanation will be focused on theory and method being used for their project. The results of the project are also being discussed here.

Chapter 3 : Methodology of the project. This chapter focusing on how the work scope is being done and that includes hardware architecture and software implementation of the project. This chapter discusses about the architecture of the project that consists the hardware design and the software implementation, along with the component and material that be

used for this project.

Chapter 4 : Result and Discussion. This chapter explains the result obtained regarding the performance and efficiency of the system in general term and overall systems operation.

Chapter 5 : Conclusion and Recommendation. Conclusion and further development or future recommendation that can be applied in this project are being discussed in this last chapter.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter is discussed precisely and covers the related works of this project with detail explanation of the Radio Frequency switch and resonators. The major overview of theories, major component, and general design in the RF switch section also will be covered.

2.2 RF Switch

RF Switch is the one of subcomponent in the Front End System to switch between transmit and receive transmission process. The parameters in the RF Switch is important before sent the signal to the next subcomponent in RF Front End System.