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DESIGN, SIMULATION AND ANALYSIS OF DEFECTED GROUND STRUCTURE
(DGS) ON HYBRID MICROWAVE INTEGRATED CIRCUIT (HMIC) FOR RFIC

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This report is submitted in partial fulfillment of the requirements for the award of
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : DESIGN, SIMULATION AND ANALYSIS OF DEFECTED GROUND
 STRUCTURE (DGS) ON HYBRID MICROWAVE INTEGRATED CIRCUIT
 (HMIC) FOR RFIC

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Specially,,,

To beloved and supportive parents,

To my kind sisters,

And to all my friends

For their Love, Encouragements, and Best wishes

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ABSTRACT

This project aims to do an analysis on Defected ground Structure (DGS) whether it is implementable on RFIC or not with using different types of materials. This project also will analyze the DGS as it works as a Band Stop Filter. This project is done in simulation; the medium that been used to designed and analyzed this project is Advanced Design System (ADS) by Agilent Company. Along the designed and analysis process the suitable substrate material and the proper size of DGS layout will be considered, so that it can be fitted in the RFIC.

ABSTRAK

Tujuan utama projek ini dijalankan adalah untuk magadakan analisis terhadap 'Defected Ground Structure (DGS)' sama ada ia sesuai diimplementasikan pada RFIC atau tidak dengan menggunakan pelbagai jenis bahan. Projek ini juga akan menjalankan analisis untuk melihat 'DGS' beroperasi sebagai 'Band Stop Filter'. Kaedah menjalankan projek ini ialah melalui simulasi, medium yang digunakan ialah 'Advanced Design System (ADS)' daripada Syarikat Agilent. Sepanjang proses mereka bentuk dan analisis dijalankan bahan yang sesuai dan saiz yang bersesuaian untuk DGS akan dipertimbangkan, ini supaya reka bentuk yang telah dibuat akan dapat diimplementasikan pada RFIC.

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LIST OF ABBREVIATIONS

DGS	-	Defected Ground Structure
HMIC	-	Hybrid Microwave Integrated circuit
ADS	-	Advance Design System
RFIC	-	Radio Frequency integrated Circuit
MMIC	-	Monolithic Microwave Integrated Circuit
IC	-	Integrated Circuit
GaAs	-	Gallium Arsenide
EMC	-	Electromagnetic Compatibility
RF	-	Radio Frequency
FET	-	Field Effect Transistor
LTE	-	Long Term Evaluation
DC	-	Direct Current

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CHAPTER I

INTRODUCTION

1.1 Project Background

In recent years, there have been several new concepts applied to distributed microwave circuits. One such technique is defected ground structure or DGS, where the ground plane metal of a micro strip or strip line waveguide circuit is intentionally modified to enhance the performance. The application of DGS can be implemented in filter design, amplifier design and antennas design. The basic element of DGS is a resonant gap or slot in the ground metal, placed directly under a transmission line and aligned for efficient coupling to the line. Each one differs in occupied area, equivalent L-C ratio, coupling coefficient, higher-order responses, and other electrical parameters. A user will select the structure that works best for the particular application. This project will be fabricated on Hybrid Microwave Integrated circuit (HMIC).

Material of this HMIC is thick film, thin film and substrate material. Usually an alumina substrate is used as the substrate, which has low loss in a microwave band, a proper value of dielectric constant, an excellent resisting property against heat and chemicals and is low in cost.

This project will focus on design, simulation and analysis of defective ground structure (DGS) on Hybrid Microwave Integrated circuit (HMIC) for RFIC and the study of DGS for HMIC. For this project Advance Design System (ADS) software will be used to design, simulation and analysis of defective ground structure (DGS) on Hybrid Microwave Integrated Circuit (HMIC) for RFIC. In the analysis, DGS as a filter will be studied for analysis. In the analysis circuit simulation and EM simulation in ADS software will be used. For the EM simulation the DGS layout will be draw, for this project dumbbell structure will be choose.

1.2 Problem Statement

Defected Ground Structure (DGS) mostly implement on micro strip board or on Monolithic Microwave Integrated Circuits (MMICs). In this project it will show the implementation of DGS on HMIC and see the performance of it in the simulation. This project will further investigate the capability and availability of DGS on HMIC material for RFIC application.

1.3 Research Objective

Design, Simulation and Analysis of Defected Ground Structure (DGS) on Hybrid Microwave Integrated Circuit (HMIC) for RFIC.

1.4 Scope of Work

Scope of project basically will explain what area or element the project will be covered. In this project the main scope is to be able to design, simulate and analysis the Defected Ground Structure (DGS). There also other scope that also important to be cover which is the theory of S-parameter, Smith chart, Hybrid Microwave Integrated Circuit (HMIC) theory and defected ground structure theory. Implementation of DGS as a filter at the cut off frequency 5 GHz. Other scope of this project is to be able to simulate the circuit using simulation tool which in this project Advance System Design (ADS) software will be use to produce all the data to be analyzed.

1.5 Project Flow

The summary for this project flow is to Design, Simulation and Analysis of Defected Ground Structure (DGS). This will be done by using ADS software that will be discuss more on Chapter 3(Methodology) of this report. After the simulation of the schematic is successfully done the part two of this project is to design the layout of the

DGS and perform the EM simulation. Other than that the suitable substrate also has to be choosing for HMIC material. Part two of this project will be explain more on Chapter V of this report.

1.6 Thesis Outline

Chapter 1 is about project background for this paper, brief introduction of Defected Ground Structure (DGS), method use, objectives and scope of works. Chapter 2 defines in details about Defected Ground Structure (DGS) and method used. Chapter 3 contains research methodology including what software that this research will be use and also the step to design the Defected Ground Structure (DGS) so that it can act as a Band Stop filter.

Chapter 4 discuss about result from this project; which is S-parameter analysis and also EM simulation analysis for schematic and layout design. Chapter 5 reveals the best design and substrate that can be implemented in Defected Ground Structure (DGS) design and works suggestion on this project.

CHAPTER II

LITERATURE REVIEW

2.1 Literature Review

In today telecommunication world Defected Ground Structure (DGS) has been extensively applied to design microwave circuits such as filters, power dividers, couplers, amplifiers, oscillators, and so on. DGS, is realized by etching only a few areas on the ground plane under the microstrip line, the basic element of DGS is a resonant gap or slot in the ground metal, placed directly under a transmission line and aligned for efficient coupling to the line and the equivalent circuit for DGS is the parallel of inductor, L and capacitor, C . Main reason for using DGS of the structure of the DGS is simple and it is easy to design the DGS pattern.

Other than that DGS also provides a significant advantage by extending its applicability to other microwave circuits, such as filters, dividers, couplers, amplifiers and oscillators.

Defected ground structures (DGS) are getting more essential in filter applications. They can be used to design compact filters and keeping the performances better than conventional filters.

Defected ground structure (DGS) is a technique where the ground plane metal of a microstrip or stripline or coplanar waveguide circuit is intentionally modified to enhance the performance. Figure 1 shows several resonant structures that may be used. Each one differs in occupied area, equivalent L-C ratio, coupling coefficient, higher-order responses, and other electrical parameters. [1]

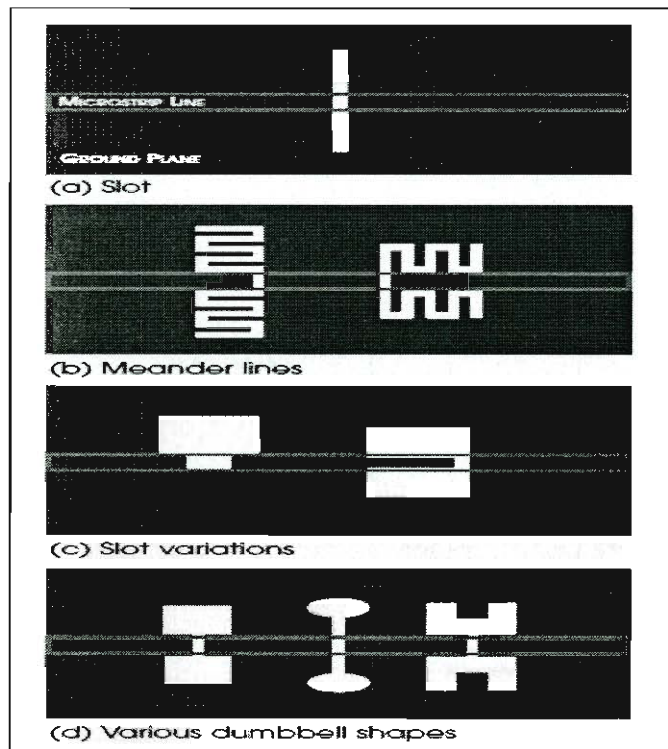


Figure 2.1: Several of DGS layout design [1]