UWB LOW NOISE AMPLIFIER

EDDIE SAZLY BIN HUSSIEN

This report is submitted in partial fulfillment of the requirements for the award of

Bachelor of Electronic Engineering (Telecommunication Electronics)

With Honours

Faculty of Electronic and Computer Engineering

Universiti Teknikal Malaysia Melaka

April 2009

© Universiti Teknikal Malaysia Melaka

UNIVERSTI TEKNIKAL MALAYSIA MELAKA

FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN

PROJEK SARJANA MUDA II

Tajuk Projek : **UWB LOW NOISE AMPLIFIER**

Sesi Pengajian : **2008/2009**

Saya **EDDIE SAZLY BIN HUSSIEN**

mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (√) :

☐	**SULIT***	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD***	(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	**TIDAK TERHAD**	

Disahkan oleh:

_____ _____

(TANDATANGAN PENULIS) (COP DAN TANDATANGAN PENYELIA)

Alamat Tetap: Kg Seberang Benoni, 89608,
Papar, Sabah.

© Universiti Teknikal Malaysia Melaka

"I hereby declare that this report is the result of my own work expect for quotes as cited in the references."

Signature : ……..

Author : EDDIE SAZLY BIN HUSSIEN

Date : 30 APRIL 2009

© Universiti Teknikal Malaysia Melaka

"I hereby declare that I have read this report and in my opinion this report is sufficient in terms of the scope and quality for the award of Bachelor of Electronic Engineering (Telecommunication Electronics) With Honours"

Signature : ……...

Supervisor's Name : En. Abd Shukur Bin Jaafar

Date : 30 APRIL 2009

© Universiti Teknikal Malaysia Melaka

DEDICATION

Special to my father and my family, thanks a lot for all your support.

For my friends, thank for helping and guide me for all this time.

Hope all of us will success and happy ever after.

© Universiti Teknikal Malaysia Melaka

ACKNOWLEDGEMENT

First of all, thanks to Allah S.W.T for the blessing and opportunity for me to finish my final year project. I would like to express my gratitude to all those who gave me the possibility to complete this thesis. Thank to the authority of Universiti Teknikal Malaysia Melaka (UTEM) for providing us the good environment and facilities to complete this project

I am deeply indebted to my supervisor En.Abd Shukur Bin Jaafar whose help, stimulating suggestions and encouragement helped me in all the time of research for and writing of this thesis..

Finally, an honorable mention goes to our families and friends for their understandings and supports in completing this project. Without helps of the particular that mentioned above, I would face many difficulties while doing this project.

© Universiti Teknikal Malaysia Melaka

ABSTRAK

Projek ini berasakan pada Penguat Rendah Hingar yang mampu berfugsi pada jalur lebar yang besar dengan bantuan *software Advance Design System (ADS)* atau *Microwave Office*. Secara amnya, Penguat Rendah Hingar boleh dikategorikan kepada dua jenis, pertama Penguat Rendah Hingar yang berfungsi untuk jalur lebar yang kecil dan yang kedua adalah Penguat Rendah Hingar yang berfungsi untuk jalur lebar yang besar. Laporan ini akan membincangkan mengenai Penguat Rendah Hingar yang berfungsi untuk jalur lebar yang besar. Masalah pada jalur lebar yang besar adalah untuk mendapat nilai gandaan yang sekata dan tinggi (atas 10dB). Untuk mengatasi masalah ini ada pelbagai kaedah boleh digunakan. Dua jenis kaedah yang akan dikaji ialah, *Cascade Single Stage Low Noise Amplifier* dan *Feedback amplifier*.

© Universiti Teknikal Malaysia Melaka

ABSTRACT

This project is mainly about designing a Low Noise Amplifier that can operate for a wide range frequency using Advance Design System (ADS) or microwave Office. Generally Low Noise Amplifier can be divided to two. First, Low Noise Amplifier that operates for a single point frequency, known as narrow band amplifier and the second is Low Noise Amplifier that can operate for a wide range frequency. This thesis will discuss more on wide range frequency. The problem in wide band frequency is the get a flat and high value of gain (above 10dB). To solve the problems, various methods can be used. Two type of method that will be cover is Cascade Single Stage Low Noise Amplifier and Feedback amplifier.

© Universiti Teknikal Malaysia Melaka

CONTENT

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

LIST OF FIGURE

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

LIST OF TERMS

UWB – Ultra Wide-Band

LNA – Low Noise Amplifier

CSSDA - Cascade Single Stage Distributed Amplifier

TWDA – Travelling Wave Distributed Amplifier

ADS – Advance Design System

AWR – Microwave Office

© Universiti Teknikal Malaysia Melaka

LIST OF TABLE

© Universiti Teknikal Malaysia Melaka

LIST OF APPENDIX

© Universiti Teknikal Malaysia Melaka

CHAPTER 1

INTRODUCTION

This chapter is describing about the basic description of Low Noise Amplifier and Ultra Wide-Band application.

1.1 Background

Ultra-wideband is a radio technology that can be used at very low energy levels for a short-range high-bandwidth communications by using a large portion of the radio spectrum. UWB transmissions transmit information by generating radio energy at specific time instants and occupying large bandwidth

Low-noise amplifiers are vital for high signal sensitivity in communications receivers. The low-noise amplifier (LNA) is a special type of electronic amplifier that used in communication systems to amplify weak signals captured by an antenna.

LNAs find application in communication systems and instrumentation equipment. Since the LNA is the first circuit block in a receiver chain, its noise performance dominates the system sensitivity.

The primary objective of this project is to achieve low noise figure and flat gain over the wide frequency range of operation. The S-parameter also will be considered in this project.

This report describes more on the design of Cascade Single Stage Low Noise Amplifier and Feedback Amplifier to get gain more than 10dB with a low noise figure for a wide frequency range.

1.2 Problem Statement

A low noise amplifier will be developed in this project. The amplifier will be design by using ADS, several analysis will be done and enhance to matching technique. The amplifier will be design to operate at very wide bandwidth which is from 3.1GHz to 10.6GHz (un-licensed). The travelling wave amplifier concept (cascade single stage distributed amplifier “CSSDA”) will be applied in developing this amplifier.

© Universiti Teknikal Malaysia Melaka

Basic LNA can only support at a one point of frequency, at that frequency the gain is high and the noise is low but it only happen at specific point, to overcome the problem , a LNA with UWB have been implement. Figure below show the effect of implementation of UWB to the LNA.

© Universiti Teknikal Malaysia Melaka

1.3 Objectives

The primary objectives of this project are:

a) To Design Low Noise Amplifier (LNA) using any FET transistor that support high frequency and produce high gain for UWB range (from 3.1GHz to 10.6GHz).
b) To using Advance Design System (ADS) simulation.
c) Implement the single stage Low Noise Amplifier with, Cascade Single Stage Low Noise Amplifier and Feedback Amplifier.
d) Compare simulation result between Cascade Single Stage Low Noise Amplifier and Feedback Amplifier.

1.4 Scope of The Project

Several scopes that focused on this project:

a) Find the suitable type of transistor that wants to be use. Thing that will be taken consideration for the transistor is:
    a. S-parameter.
    b. Noise Figure.

b) Basic LNA:

    a. Calculate the gain value from the S-parameters
    b. Determine the stability of the transistor
    c. Determine the noise figure of the transistor
    d. Design and matching the circuit

c) LNA UWB:

    a. Implement Cascade Single Stage Low Noise Amplifier. design in Basic LNA
    b. Implement Feedback Amplifier in Basic LNA
    c. Stimulate the LNA using ADS / Microwave program

© Universiti Teknikal Malaysia Melaka

d. Record the result
e. Compare the result between Feedback Amplifier and Cascade Single Stage Low Noise Amplifier

© Universiti Teknikal Malaysia Melaka

CHAPTER 2

LITERATURE REVIEW

This chapter will describe about the past researches review that related to the project. This literature review is important to make this project relate with the past researches and for the next chapter.

Before proceed in the detail about the researches theory and information that related to the project, it is better to see the evidence overall past researches about single point Low Noise Amplifier, Feedback Amplifier and Cascade Single Stage Amplifier. Through the single point LNA, the matching technique has been done. Basically the matching technique that will be considered is Lumped Element and Stub Matching

© Universiti Teknikal Malaysia Melaka