COMPUTER AIDED LOW NOISE MICROWAVE AMPLIFIER DESIGN

Presented in partial fulfilment for the award of the

Bachelor of Electrical Engineering

MARA Institute of Technology
40450 Shah Alam
Selangor Darul Ehsan

USAHA JAYA MARA

SYED BADRI SHAM BIN SYED ABDULLAH
School of Electrical Engineering
MARA Institute of Technology
40450 Shah Alam
DEC 1996

ACKNOWLEDGEMENT

The success of this project was due in part to various personnel involved at the each or every stage. It is to this effect that I would like to convey my most sincere and heartfelt gratitude to my supervisor Dr. Zaiki Bin Awang, who has given many valuable suggestions and encouragement.

I would also like to convey my most sincere and heartfelt gratitude to the project co-ordinator, En Zaini and other lecturers for their constructive criticism, guidance, suggestion and valuable help for the project.

My special thanks also go to all laboratory and workshop technicians who gave me valuable information for the completion of this project.

Last but not least, my special thanks to my family who gave unrelenting encouragement and to all the lecturers and friends who gave me the motivation for this piece of work.

" TO MY PARENTS I LOVE YOU "

SBSR' DIS 96

ABSTRACT

The design objective was to build a low noise amplifier with a gain of 12dB, VSWR less than 2 and noise figure of 3.5dB. The amplifier was to be fabricated on microstrip with a thickness of 0.8mm and a dielectric permittivity of 2.35. This project also aimed to expose the student to the design procedures involved in such application. The amplifier was built from basic, therefore a considerable amount of time was spent on the design procedures, until now known in the industry as a black art. A research grant will be made to enable amplifier fabrication on microstrip and then to analyse its characteristics using scalar or vector analyser.

The purpose of this thesis is to present the analysis and design of a low noise microwave amplifier. Microwave techniques have been increasingly adopted in many electronic systems, such as space communications, radar systems and missile electronic systems. As a result of the accelerating growth of microwave technology, research, design and development in institutes and industries, students preparing for and electronics engineers working in the microwave field need to understand the analysis and design of microwave amplifiers for the production of microwave electronic components and systems.

In the design of a microwave module or subsystem it is often desirable to interconnect many active and passive elements together. The commonly used microwave solid-state devices are in the form of two ports. In this thesis we are concerned with the S-parameter theory, which will be used in chapters for designing microwave matching networks. In general, microwave amplifiers can be operated in class A, B, and C modes. In class A, the collector or drain

TABLE OF CONTENTS

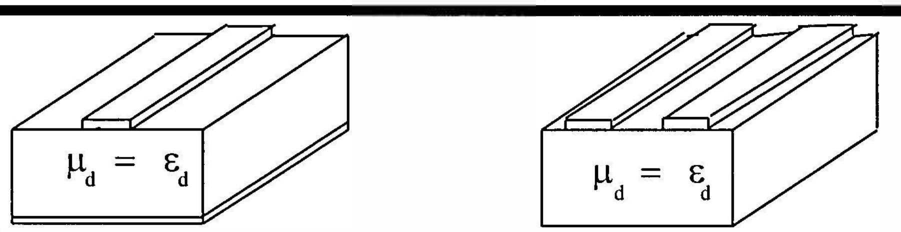
CHAPTER 1. MICROSTRIP CIRCUITS AND TRANSMISSION LINES.

1.0 Microstrip circuits

A microstrip line consist of a strip conductor and a ground plane separated by a dielectric material as shown in Figure 1.0. The electric and magnetic field lines are not contained entirely in the substrate, so the wave propagation in the microstrip line is not a pure transverse electromagnetic (TEM) mode but a quasi-TEM mode. For a quasi-TEM mode, the phase velocity of the propagation wave in a microstrip line is given by [3]

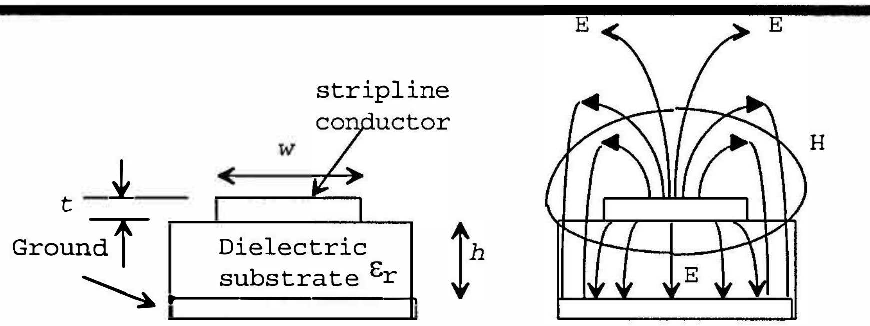
$$\upsilon_p = \frac{c}{\sqrt{\varepsilon_{re}}} \qquad (1\text{-}0)$$

where $c = 3 \times 10^3$ is the velocity of light in vacuum.
ε_{re} = effective relative dielectric constant of the substrate board



a. Microstrip line b. Coplanar stripline.

Figure 1.0 Microwave stripline



a. Schematic diagram b. Field lines.

Figure 1.1 Diagrams for a microstrip line.

where μ_d = dielectric permeability. t = conductor thickness

ε_d = dielectric permittivity. h = substrate thickness

E = electric field H= magnetic field ε_r = relative permittivity.