

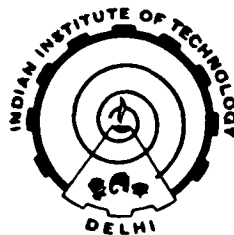
THEORETICAL CHARACTERIZATION OF CERTAIN FINLINE CONFIGURATIONS

by

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for the degree of
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to the

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CERTIFICATE

This is to certify that the thesis entitled "Theoretical Characterization Of Certain Finline Configurations" being submitted by P V Ramakrishna to the Department of Electrical Engineering, Indian Institute of Technology, New Delhi, for the award of degree of Doctor of Philosophy is a bonafide research work carried out by him under my supervision and guidance. The results contained in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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19.4.91

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ABSTRACT

During the last 10-15 years, millimeter wave frequencies have been finding increasing applications in communications. One of the most popularly used transmission lines for these frequencies is the finline. Many components and subsystems have been realized in finline topologies. The theoretical computation of the propagation parameters is a very important tool in the design of finline circuits. Two of the most popularly used methods for this purpose are the Spectral Domain Analysis (SDA) and the Method of Lines (MOL). These two methods are computationally very efficient and also are very versatile in being applicable to a large variety of planar transmission lines. However, both these methods are efficient only in computing the dominant mode characteristics and are incapable of furnishing the higher order modes of finlines.

One of the methods capable of providing the higher modes of finlines efficiently is the Singular Integral Equation (SIE) method and is already available in the literature. One of the aims of this thesis is to present an alternative SIE derivation for computing efficiently the propagation characteristics of dominant mode as well as the higher order modes of finlines. Firstly, because finned waveguides have their own importance, the SIE derivations are presented for obtaining the TE and TM modes of hollow finned waveguides. Secondly, the SIE derivations are presented for the hybrid modes of finlines. These SIE derivations are largely based on the SIE derivation proposed by R Mittra and T Itoh for the case of microstripline. The main advantage of the

SIE derivations presented in this thesis as compared to the well known SDA and MOL are, 1) their ability to furnish the higher order modes efficiently and 2) the exact nature of the derivations, i.e., there is no need to make approximations at any stage of the derivations or computations.

The other aim of the present thesis is to investigate the efficacy of applying certain well known methods to characterize finlines containing anisotropic media. Firstly, many substrates used with finlines inherently exhibit a certain amount of anisotropy, and secondly, anisotropic materials in the form of magnetized ferrites are deliberately introduced into finlines for the realization of certain components. Although, both SDA and MOL have been reformulated to incorporate each of these anisotropies, two methods which have been very popularly used with conventional rectangular waveguides containing anisotropic media have not been tried out with finlines. These are, 1) the Generalized Telegraphists Equation (GTE) method and, 2) the Perturbation method. The derivations of these two methods for the case of finlines are presented in this thesis and numerical results are presented to validate the same. The numerical results presented indicate that while the GTE could work well albeit with certain limitations, the perturbation method works very well and is sufficient to deal the anisotropies encountered in practice. Also, the perturbation method is extremely simple and could work as a small appendage to any of the already existing rigorous methods for finlines on isotropic substrates and there is no need to reformulate these methods to incorporate the anisotropy.

CONTENTS

	Page No.
Acknowledgments	i
Abstract	iii
1. Chapter I: Introduction	1
Sec.I Printed Transmission Lines	1
Sec.II Problem Description and Significance	4
Sec.III Organization of the Thesis	11
2. Chapter II: Mode Functions of Finned Guides	17
Introduction	17
Sec.I TM Modes of Bilateral Finned Guide	19
Sec.II Derivation for TE Modes of Bilateral Finned guide	27
Sec.III Modifications For Unilateral Finned Guide	37
Sec.IV Discussion on Mode Functions and Singularity	40
Summary	42
Appendix I	43
Appendix II	48
Appendix III	56
3. Chapter III: Hybrid Modes of Bilateral And Antipodal Finlines	59
Introduction	59

Sec.I	Hybrid Modes of Bilateral Finline	60
Sec.II	Modifications for Antipodal Finline	72
	Summary	76
	Appendix IV	77
4. Chapter IV:	Hybrid Modes of Unilateral Finline	81
	Introduction	81
Sec.I	Derivation of Hybrid Modes of	
	Unilateral Finline	81
	Summary	94
	Appendix V	95
	Appendix VI	100
5. Chapter V :	Finlines Containing Anisotropic Media	103
	Introduction	103
Sec.I	Generalized Telegraphists Equation	
	Method	104
Sec.II	Perturbation Method	112
	Summary	117
	Appendix VII	118
6. Chapter VI:	Numerical Results And Discussion	123
	Introduction	123
Sec.I	Numerical Results of Computations	123
Sec.II	Discussion	131
	Scope For Future Work	138
7.	REFERENCES	167