RESEARCH ON SPECTRAL DOMAIN IMMITTANCE APPROACH

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ABSTRACT

In this paper, we have obtained the equations of electrodynamics for a gyrotropic medium using the Maxwell's equations. Through the Fourier Transforms (FT), the admittances of TM and TE modes in the electrically gyrotropic substrate and the magnetically gyrotropic substrate are given. Then we can use the spectral domain immittance approach to analyse the finline structures with a gyrotropic medium. The propagating characteristics of the dominant mode in magnetized-ferrite-loaded double-layered finlines are studied, numerical results are presented which could be used in designing a finline displacement isolator.

Key words: Spectral domain immittance approach; Finlines; Ferrites; Numerical computational methods; Gyrotropic medium

I. INTRODUCTION

The main transmission lines used in the production of microelectronic circuits are the microstrip line, the finline, and the suspended microstrip. The finline, which was developed by Meier in 1972, has found frequent applications in millimeter-wave integrated-circuit design (mixers, oscillators,
filters, isolates, etc.) with increasingly high frequencies [1]. This is attributed to their favorable properties, such as low dispersion, broad single-mode bandwidth, moderate attenuation, and compatibility with semiconductor devices. Among various possible configurations, unilateral and bilateral finlines are of particular interest (see Fig. 1).

![Fig. 1. Finline configurations. (a) Unilateral finline. (b) Bilateral finline.](image)

To this date, the propagating characteristics of finlines have been obtained with various methods. The spectral domain technique [2, 3] is applied to a finline structure. In [3], Espes et al. have studied a new type of unilateral finline—the asymmetrical structure finline (ASFL), and pointed out its advantages in space applications. Xu has analyzed the finline structures with the finite element method (FEM), and developed a general rule of the effect of the fin thickness [4]. Wu et al. have proposed to analyze the finline structure with boundary element method (BEM) [5]. On the other hand, some engineering approximations are involved in the work in [6].

In above methods by comparison, we think that the spectral domain technique is one of the most simple rigorous methods. In this method, the information on the propagation constant at a given frequency is extracted from algebraic equations that relate Fourier transforms of the currents on the fins to those of the electric field in the dielectric-air interface. The advantage of using spectral domain technique in finline structures is that the integral equations in the space domain are transformed into the algebraic equations in the spectral domain, but we also see that this method is very complex when the layers of medium are increased. In the year 1979, Itoh proposed the spectral domain immittance approach (SDIA), and simplified the course of getting the eigenvalue equation [7].