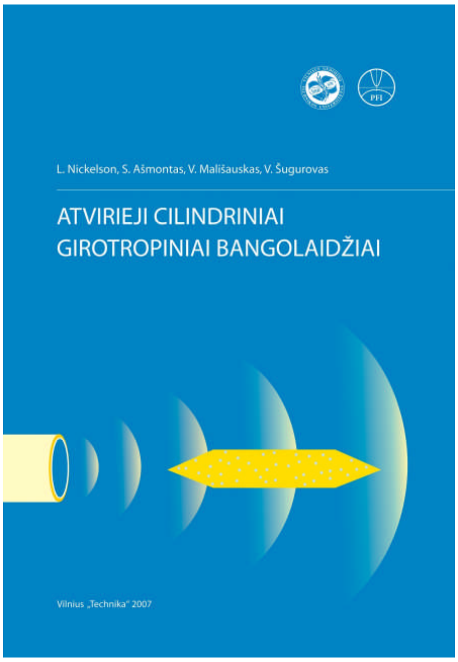
T170 *ELECTRONICS*
ELEKTRONIKA

Referee Review on a Monograph

L. Nickelson, S. Ašmontas, V. Mališauskas, V. Šugurovas, "Open cylindrical gyrotropic Waveguides".

Semiconductor Physics Institute, Vilnius Gediminas Technical University, Vilnius: Technika, 2007, 248 p., illustr. 62, tables 31, bibliography 123, appendixes 3.



This book contains the author theoretical and experimental investigations of open circular cylindrical gyrotropic waveguides. The book consists the detailed solutions to *Maxwell*'s equations for open gyrotropic or layered gyrotropic-dielectric waveguides.

The book has five chapters. The first chapter is devoted to literature review. In this chapter a large amount of literature was examined on the cylindrical dielectric waveguides made of various materials from 1947 till the present time. The open circular cylindrical waveguides have very good electrodynamical characteristics and are relevant up to the present time. The majority of the articles quoted are devoted to theoretical research of characteristic screened waveguides. This review shows that there is a detailed analysis of open dielectric waveguides only for waveguides made of isotropic dielectric materials. There are only isolated articles on open cylindrical gyrotropic waveguides and only certain questions were investigated. The presented book completes what is lacking in other articles about open circular cylindrical gyrotropic waveguides.

In the second chapter there is a general solution of *Maxwell*'s equation for an open circular cylindrical gyrotropic and layered gyrotropic-dielectric waveguides in this chapter. Here also are dispersion equations for these $\tilde{\varepsilon}$ and $\tilde{\mu}$ gyrotropic waveguides. In the authors' research a $\tilde{\mu}$ gyrotropic waveguide has features of a longitudinally magnetized ferrite waveguide and a $\tilde{\varepsilon}$ gyrotropic waveguide has features of a semiconductor waveguide placed in longitudinal magnetic field. The solution for gyrotropic material constructed as a sum of two partial plane electromagnetic waves that transform to *E*-mode and *H*-mode in infinite ferrite material. There are detailed solutions of electrodynamic problems in this chapter.

The third chapter describes the numerical investigations of the longitudinally magnetized ferrite waveguides. There are dispersion dependences of the main HE_{11} and nine higher HE_{01}, EH_{01}, HE_{21}, EH_{11}, HE_{12}, HE_{31}, EH_{21}, HE_{02}, EH_{02} modes. The dispersion dependences of the main mode were analyzed for left and right polarizations. This book shows that the main and higher mode dispersion characteristics depend on the ferrite magnetizations. The central working frequencies and bandwidths of waveguides at different frequency ranges were determined. The bandwidth of certain ferrite waveguide can reach as high as 58 %. The cutoff frequencies for the main and higher modes are shown in the figures of chapter three. In this chapter there are dependences of the absolute and relative differential phase shift of the ferrite waveguide on the ferrite magnetization. One can see here comparisons of the theoretical and experiment dependences of the differential phase shift modulus for three ferrite waveguides. The authors' calculations agreed with the experimental results presented here. In this chapter there are nineteen pictures with four tables.

In the fourth chapter the ferrite cylinder is covered by a dielectric layer. Dispersion characteristics of layered waveguides are shown. There are different electrodynamic characteristic dependences on certain ferrite magnetization at different thicknesses and permittivities of the dielectric layer. Dispersion dependences for the main and two higher modes of both polarizations at several magnitudes of the ferrite magnetization are shown. In this chapter there is analysis of the phase shift of the main mode for both polarizations on the ferrite magnetization. Also there are dependences of the differential phase shift of the main mode HE_{11} on the thickness of a dielectric layer at different dielectric permittivities. There are dependences of the differential phase shift of the left and right polarized mode HE_{11} on the dielectric layer permittivity at different thicknesses of the dielectric layer. There are dependences of losses on the frequency for ferrite waveguides with and without a dielectric layer. The losses of the ferrite waveguides with different thicknesses and permittivities of the dielectric layers were investigated. The cutoff frequencies for the main and higher modes are shown in the figures of the chapter. The waveguide central working frequency and bandwidth are presented in the figures in this chapter. The losses of the ferrite-dielectric waveguides can be less when compared to the waveguides without a dielectric layer at a certain frequency range. So the parasite modulation of the signal that is propagating on the layered ferrite-dielectric waveguide will be less. Modulators with a wide bandwidth were created using these calculations. The authors of this book have a patent on a phase shifter with a wide bandwidth which was developed based on a circular cylindrical ferrite-dielectric waveguide. This fourth chapter contains eighteen pictures and ten tables with numerical results for certain ferrite-dielectric waveguide analysis.

In the fifth chapter the electrodynamic numerical analyses of circular cylindrical semiconductor *n*-InSb, *p*-Si and *p*-Ge waveguides placed in a longitudinal constant magnetic field are shown. The dispersion dependences of certain solid plasma waveguides at several magnetic inductions and different free carrier concentrations of semiconductor materials are shown in this chapter. Here were analyzed electrodynamic characteristics of the main HE_{11} and higher EH_{11}, HE_{12}, EH_{12}, HE_{13} waveguide modes. Dependences of the cutoff frequency on the concentration of the free carrier charges are presented. The concentration of the free carrier charges can change by four orders. The central working frequency and bandwidth of *n*-InSb, *p*-Si and *p*-Ge waveguides were determined at different concentrations of electrons or holes. The figures show that the cutoff frequencies shift to the lower frequencies when the constant magnetic field increases and the electron concentration decreases for the modes HE_{11} and EH_{11}. The authors described the effect which permits one to switch off a circular cylindrical semiconductor waveguide from a working regime. The numerical analyses of *n*-InSb waveguides show that there is an electron concentration at which a magnitude of the cutoff frequency of modes HE_{11} and EH_{11} changed by a jump suddenly. It is possible to switch on and off the waveguide working regime when one changes the carrier concentrations. There are different characteristic comparisons for *n*-InSb, *p*-Si and *p*-Ge waveguides. The final chapter contains twenty-four pictures and three tables.

The monograph can be useful for scientists, practitioner-researchers, university master's degree candidates and university PhD students in microwave and telecommunication fields.

I would like to note, that a material of the book in the second, third and fourth chapters is presented consistently and in details. First four chapters are logically finished. The fifth chapter obviously concedes to the previous chapters. For example, semiconductor *p*-Ge, *p*-Si waveguides placed in a longitudinal constant magnetic field are investigated only in enough narrow intervals of concentration in comparison with *n*-InSb waveguide. Certainly, it would be interesting to analyze these semiconductor waveguides in details. Besides speaking about perspective works on this subject it would be interesting to investigate electromagnetic field distributions of the main and the higher modes of these waveguides. I wished to note you that the book is carefully edited. The book as a whole leaves good impression.

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