



Optimized Guide Polarizer for Extended C-Band

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Abstract — This article presents the design and characteristics of new wideband polarizer based on a square guide with diaphragms. Matching and polarization characteristics of the guide polarizer have been simulated and optimized. Frequency dependences of the simulated characteristics are presented. Developed optimized guide polarizer can be applied in modern satellite antennas.

Keywords: microwave engineering, telecommunication systems, guide polarizer, circular polarization, differential phase shift, crosspolar isolation, axial ratio, satellite telecommunication systems.

INTRODUCTION

Nowadays, new extended frequency bands are widely applied in modern satellite information systems, terrestrial communications and radio astronomy [1–6]. In this regard the development and simulation of new designs of waveguide iris polarizers is a relevant problem [7–18]. Iris polarizers are an essential part of the feeds of satellite reflector antennas. The application of iris polarizers allows to operate at two orthogonal circular polarizations. Consequently, the volumes of transmitted information in the telecommunication system increase in two times.

DESIGN OF THE DEVELOPED IRIS POLARIZER

A waveguide iris polarizer is a microwave device, which performs the conversion of the electromagnetic waves with orthogonal circular polarizations into electromagnetic waves with linear polarizations. This operation is performed by the introduction of an additional differential phase shift of 90° between the modes of a waveguide with orthogonal polarizations.

Typically, iris polarizers and orthomode transducers are based on circular and coaxial waveguides [19], and square waveguides [20–32]. The main advantage of the iris polarizer is its most wideband operation compared to other designs. Besides, it provides efficient electromagnetic characteristics and good matching of a structure. The main disadvantage is the increase of the iris polarizer's length for the wide and ultra wide operating bands. Iris polarizers based on guides with irises are technological devices and they are easily fabricated by milling.

Inner structure of typical structure of the waveguide iris polarizer is shown in Fig. 1. The iris polarizer is based on the square waveguide and several diaphragms.

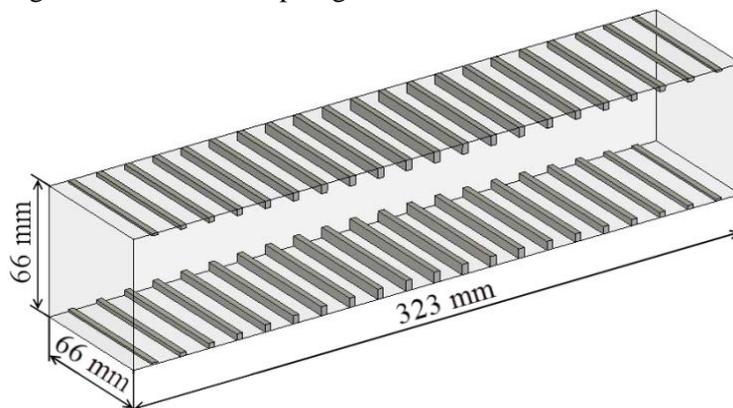


Fig. 1. The structure of a iris polarizer based on the square waveguide with irises

ELECTROMAGNETIC CHARACTERISTICS OF DEVICE

The sizes of the waveguide and irises were varied for the optimization. The most important parameter of a iris polarizer is differential phase shift. Optimized differential phase shift of the iris polarizer is demonstrated in Fig. 2. The introduced differential phase shift is $90^\circ \pm 3^\circ$ in the operating satellite band 3.4–4.8 GHz. The crosspolar isolation of the iris polarizer is higher than 31 dB. Fig. 3 presents the frequency dependences of VSWR. The solid curve corresponds to the vertical polarization. The dashed curve corresponds to the horizontal polarization. As one can see, VSWR is less than 1.1 for both polarizations of waveguide modes.

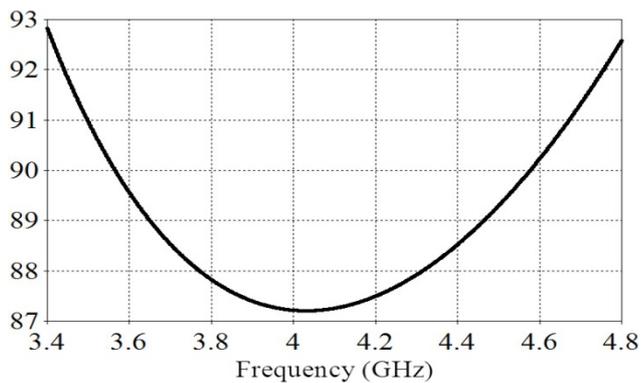


Fig. 2. Differential phase shift of a iris polarizer in the extended satellite C-band

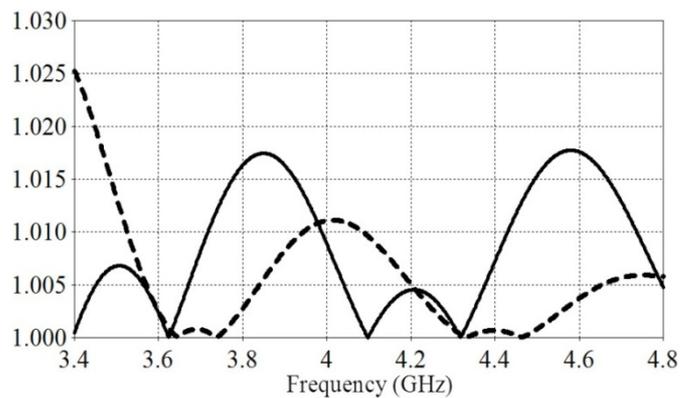


Fig. 3. VSWRs of a iris polarizer in the extended satellite C-band for both polarizations

CONCLUSIONS

Consequently, a new iris polarizer has been developed and optimized in the article. The structure consists of a square waveguide with metal irises in it. Developed iris polarizer provides efficient phase characteristic and good matching with low VSWR level. Developed iris polarizer can be widely applied in modern satellite antenna systems.

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