Wideband Iris Polarizer for Satellite Systems

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Abstract

This research presents the design and characteristics of new wideband polarizer based on the square waveguide with irises. Matching and polarization characteristics of the polarizer have been simulated and optimized. Frequency dependences of the characteristics are presented. Developed polarizer can be applied in satellite information systems.

Keywords: microwave devices, telecommunication systems, polarizer, differential phase shift, crosspolar isolation, axial ratio, satellite information systems, antenna systems.

INTRODUCTION

Nowadays, new extended frequency bands are widely applied in modern satellite telecommunication systems and radio astronomy. In this regard the development of novel designs of waveguide polarizers is a relevant problem [1–5]. Such polarizers are an essential part of the feeds of satellite reflector antennas [6–8]. Waveguide polarizers based on sectoral [9–13] and coaxial ridged waveguides [14–16] are frequently applied in dual-band antenna feeds. The application of polarizers allows to operate at two orthogonal circular polarizations. Consequently, the volumes of the transmitted information in the system increase in two times.

SUGGESTED POLARIZER DESIGN

A waveguide 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, polarizers and orthomode transducers are designed based on circular, coaxial [17–19], and square waveguides [20–27]. 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 polarizer's length for the wide and ultra wide operating frequency bands. In addition, polarizers based on the waveguides with irises are technological devices and they are easily fabricated using modern approaches.

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

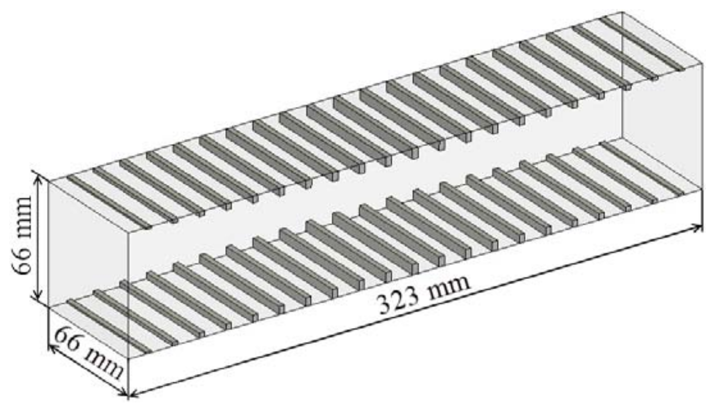

Fig. 1. The structure of a polarizer based on the square waveguide with irises

FREQUENCY PERFORMANCE OF THE DEVELOPED POLARIZER

The sizes of the waveguide and irises were varied for the optimization. The most important parameter of a polarizer is differential phase shift. Optimized differential phase shift of the polarizer is demonstrated in Fig. 2. The introduced differential phase shift is 90°±3° in the operating satellite band 3.4–4.8 GHz. The crosspolar isolation of the polarizer is higher than 31 dB. Fig. 3 presents the frequency dependences of VSWR. The solid curve correspond 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.

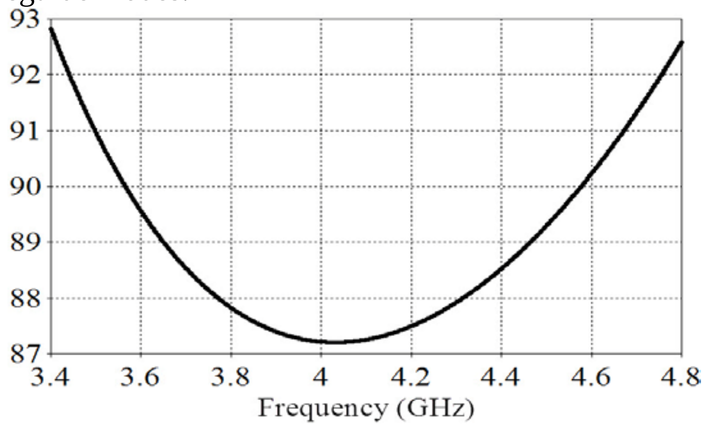

Fig. 2. Differential phase shift of a polarizer in the extended satellite C-band

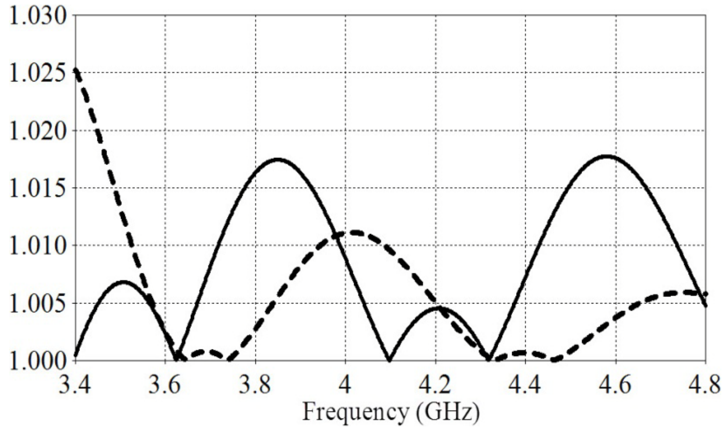

Fig. 3. VSWRs of a polarizer in the extended satellite C-band for both polarizations

CONCLUSIONS

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

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