Diplexer on Cylindrical Waveguide with Anisotropic Crystal

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Abstract—It is proposed the diplexer, which is possible to separate the signals of centimeter wavelength band by frequencies, polarizations, and different waveguide channels, which is characterized by small mass dimension parameters and signal loss in a pass band.

INTRODUCTION

Microwave diplexers are important components of the systems of satellite and mobile communication. They are used for transmission and reception of the signals with single antenna. Diplexers are also used for separation of complex signal by two different channels and separate transmission of the signals. Due to interaction of two filters in the diplexer, its characteristics can be different from ones of two independent filters.

Now there are the most widely spread the microwave filters in form of waveguide electric resonators and T-splitters [1–3], and also TX and RX filters [4–8]. The drawback of such diplexers is their enough great mass dimension parameters.

If we compare known microwave filters by minimum of the loss in case of identical value of the pass band or stop band then waveguide filters are characterized by the best parameters. It is explained by fact that waveguide and waveguide –dielectric resonators have the greatest Q-factor in centimeter wavelength band.

Waveguide filters are good for application in fixed equipment where requirement of minimum of the signal loss is more important than mass dimension parameters. But for small-sized radio electronic equipment, applied in aviation, satellite communication and television, mass dimension parameters are the most important factors. At the same time there is great experience of miniaturization of the microwave filters allowing to conclude that energy parameters conflict with mass dimension parameters [9].

During the process of the compromise obtain between these factors there are proposed the filers on a basis of anisotropic dielectrics. Anisotropy of dielectric permittivity obtained by the crystal during its growing process in some cases is undesirable property (complexity of the mathematic modeling; anisotropic media resonators Q-factor decrease, etc). In this paper it is proposed the diplexer on a basis of anisotropic waveguide, using mentioned property.

2. THE DEVICE. ELECTRODYNAMIC ANALYSIS

There are developed and fabricated the devices on a basis of anisotropic dielectrics [9], in particular, it is developed the diplexer possible to separate simultaneously the signals of centimeter wavelength band by their frequencies, polarizations and different waveguide channels, which is characterized by small mass-dimension parameters.

The problem stated is solved by application of the dielectric disk from anisotropic material in waveguide or coaxial variants. Due to this the resonator amplitude-frequency response has two pass bands, whose resonance frequencies are defined by geometric dimensions of the waveguide and disk and also by the components of the disk permittivity tensor in correspondent directions.

Dependently on requirements list to the device characteristics (such as broadbandness, operation frequency band, initial loss in the pass band or stop band, etc.) it is necessary to apply specific dielectric type. Overwhelming majority of synthesized single-crystal materials are characterized by small value of dielectric