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The microstrip filters based on electromagnetic crystal of resonators 2d disposition*

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Abstract. Filters of the 6th order, based on 2D electromagnetic crystals were developed. Application in structures of resonators with convolved and earthed on its base with strip conductors enables the implementation of filters having high frequency-selective properties and demanded in the aerospace equipment.

While developing and researching new structures of frequency-selective microwave devices [1] used in missile-space technology, developers traditionally try to increase their selective properties [2-3], to improve manufacturability, to reduce their size and to lower the cost of finished products.

This paper presents the bandpass filters with perspective microstrip resonators periodically arranged on two spatial coordinates that electromagnetically interact with each other.

It is necessary to note that in such resonator (Fig. 1) with original folded segments of strip conductors 2-1 connected together through general grounding 4 on the basis, due to a large step of wave resistance in line segments, the frequency of higher oscillation modes increase significantly.

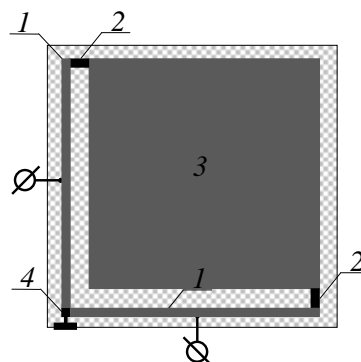


Figure 1. Topology of the strip conductors (black or gray) of microstrip resonator.

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Parametric filters' synthesis on the basis of electromagnetic crystal was conducted by numerical electrodynamic analysis of 3D models in which ports with impedance of 50 ohms were conductively connected with the strip conductors of input and output resonators. For objective comparison of the characteristics of the devices, the same substrates with dielectric permittivity $\epsilon = 9.8$ and thickness $h = 1$ mm (material - polykor) were used. Also, the center frequency of the bandwidth (BW) $f_0 \approx 1.0$ GHz and the relative width of the BW - $\Delta f/f_0 \approx 20\%$ were recorded.

The location of six resonators in two filters' structure is chosen in such a way that the inductive bond coupling between them prevails (Fig. 2). Herewith through holes l in the substrate are filled with a conductor grounded at one end on the base.

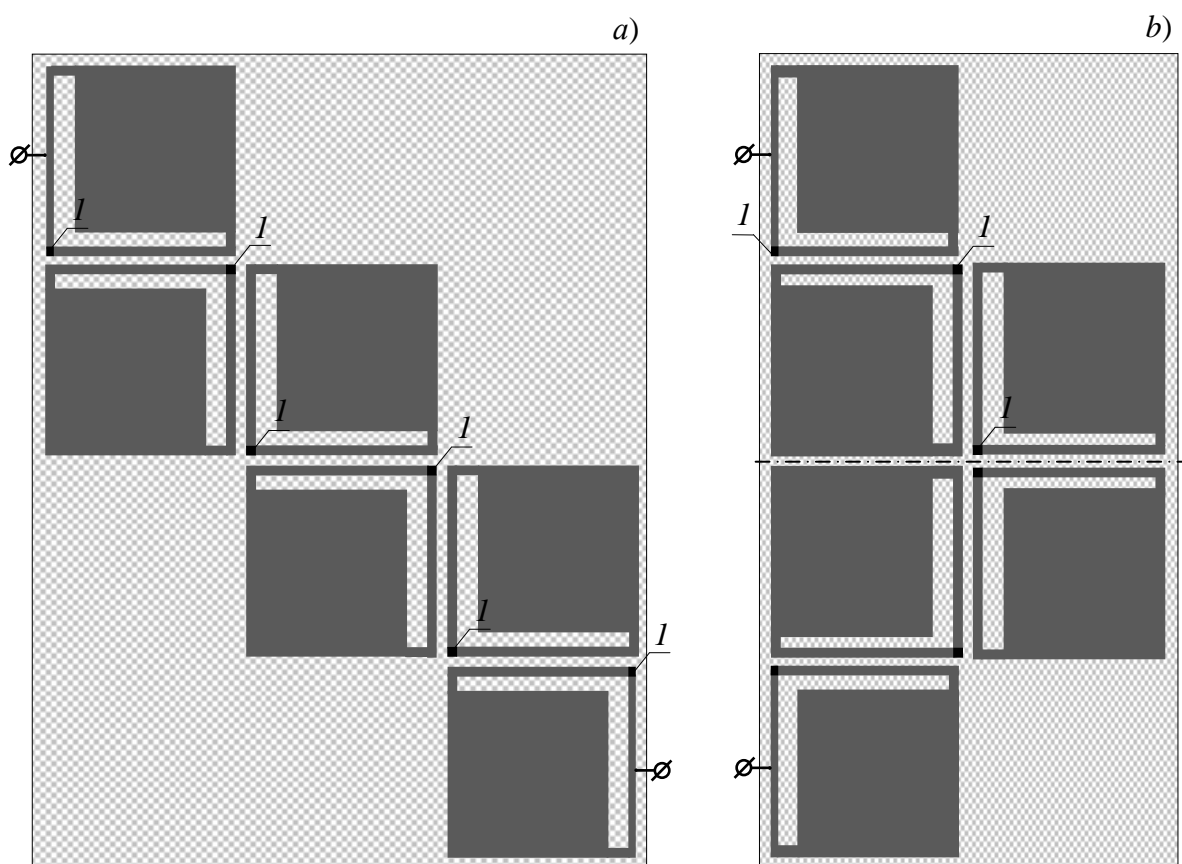


Figure 2. Topology of the 6th order filters strip conductors, based on 2D electromagnetic crystal. *a)* – with vertical displacement of resonators ranks, *b)* – with a defect of two absent outermost resonators.

In amplitude-frequency characteristics (AFCs) of the synthesized filter of 6th order one can be seen (Fig. 3) power attenuation poles, which increase the steepness of the slopes of the bandwidth and strengthen the suppression of power at low-frequency and extended high-frequency stop band.

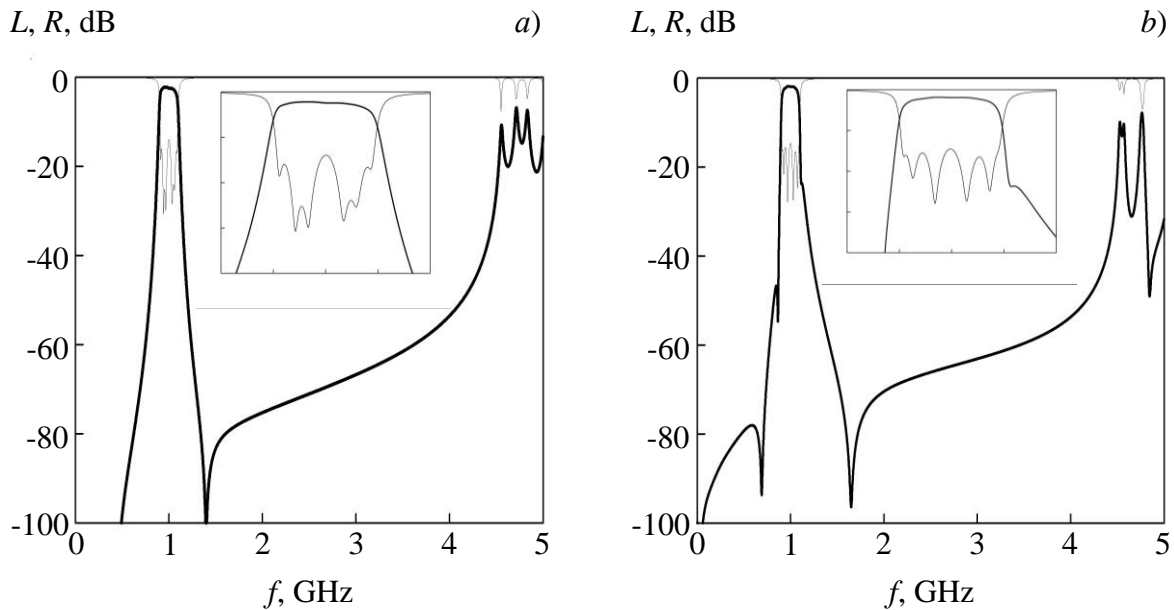


Figure 3. AFCs (in the wide and narrow band) of 6th orders filters. *a)* – used in calculations the topology of conductors presented in Fig. 2*a*, *b)* – in Fig. 2*b*.

In this connection, new structures of bandpass filters based on two-dimensional electromagnetic crystal are proposed. It has been shown that it is necessary to find such spatial configuration of the microstrip resonators with folded and grounded at the base of the strip conductors to make the propagation of electromagnetic waves occur consistently from one resonator to another. This allows realizing 6th order filters with high frequency-selective properties.

References

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