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The microstrip wideband filter*

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Abstract. The filter of high frequency-selective properties is developed. The central six-mode resonator of the design which can be used in the aerospace equipment is electromagnetically connected with six single-mode resonators. The good agreement of the calculated data in comparison with the data received on the experimental model of a design is shown.

Recently microstrip multimode resonators attract the developers of frequency-selective microwave devices [1, 2] that are widely needed in space communication and navigation systems. First of all, it is connected with the possibility of a substantial reduction of structural dimensions by decreasing the number of resonators in them, moreover, without deterioration of frequency-selective properties. In such resonators due to the use of specific form of strip conductors, one can bring natural frequencies of the lowest *n*-oscillation modes together. As a result multimode resonator filter has *N*-order, by which, as it is well known [3, 4], its frequency selective properties are determined, exceeding the number of resonators in it in *n*-times.

In the present work, the structure of developed broadband microstrip filter (Fig. 1) in which central 6-mode resonator *4* is electromagnetically connected with six single-mode resonators *1*-*3* is given. Parametric filter synthesis was carried out with the help of numerical electrodynamic analysis of 3D models. The substrate with a dielectric constant $\varepsilon = 9.8$ and thickness $h = 1$ mm (material - polykor), while the center frequency of the bandwidth and its relative width were recorded as: $f_0 \approx 3.5$ GHz and $\Delta f/f_0 \approx 140\%$, respectively.

In this case the device adjustment was executed by «manual» parametric synthesis with the selection of the strip conductor portions topology geometrical sizes, i.e. length, width and gaps of regular areas, specified on Fig. 1 by positions numbers.

While 3D modeling, for added tuning of return loss level in the bandwidth a discontinuity of lines resistance $Z_1/Z_2 \approx 0.22$ was used. It is realized by introduction into the structure (perpendicular to the conductor segments *1* from each side) the two sequentially connected segments of strip conductors with wave resistance Z_1 and Z_2 (Fig. 1), respectively. In this case the first segment of this kind becomes a filter port. This makes the coordination of the structure with the microwave path easier.

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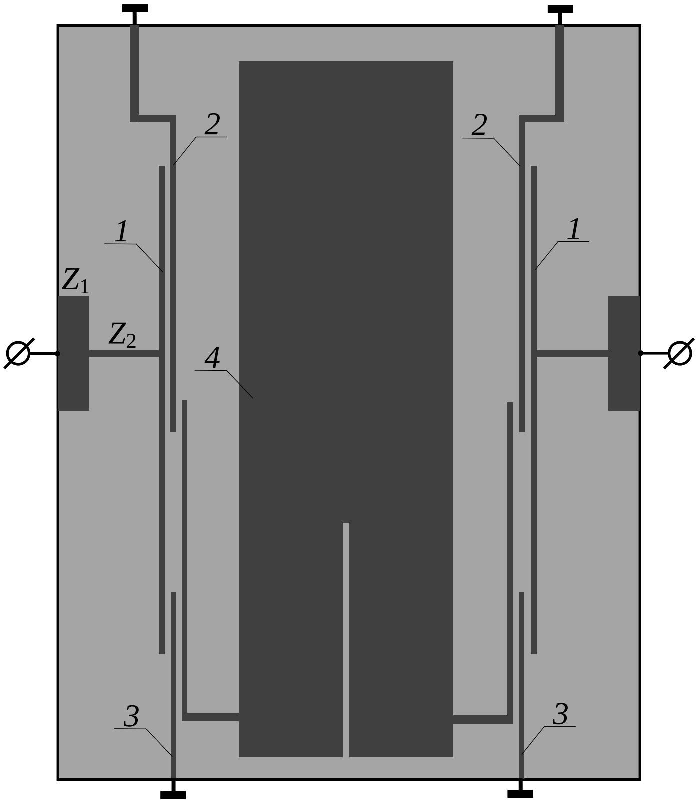

Figure 1. Topology of the strip conductors of microstrip wideband filter.

The geometrical dimensions of the experimental structure (Fig. 2), produced by photolithography, were as follows: 22.6×16.7×1.0 mm^3.

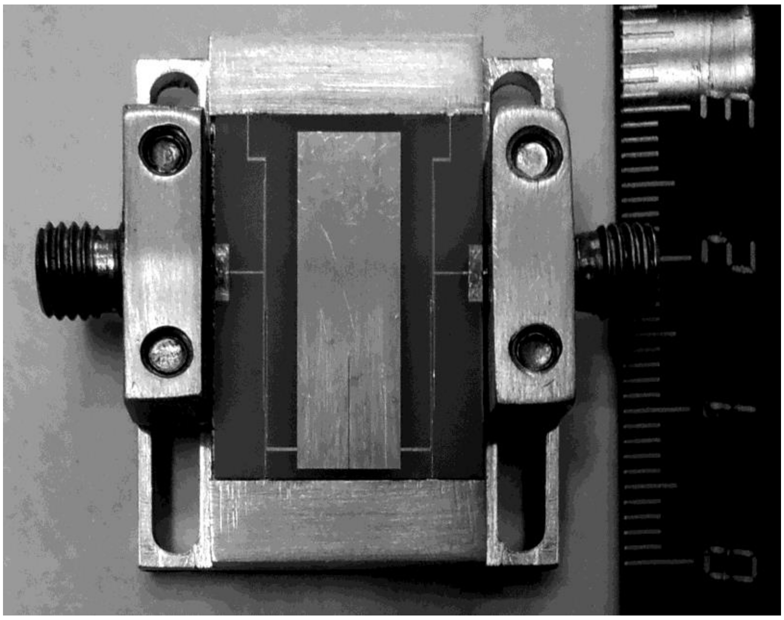

Figure 2. The photograph of fabricated filter.

In the amplitude-frequency characteristic (AFCs) of high order filter one can monitor power attenuation poles (Fig. 3), which increase the steepness of the slopes of the bandwidth and increase the power suppression at frequencies of stop band. Minimum losses in bandwidth do not exceed the value of -1.1 dB.

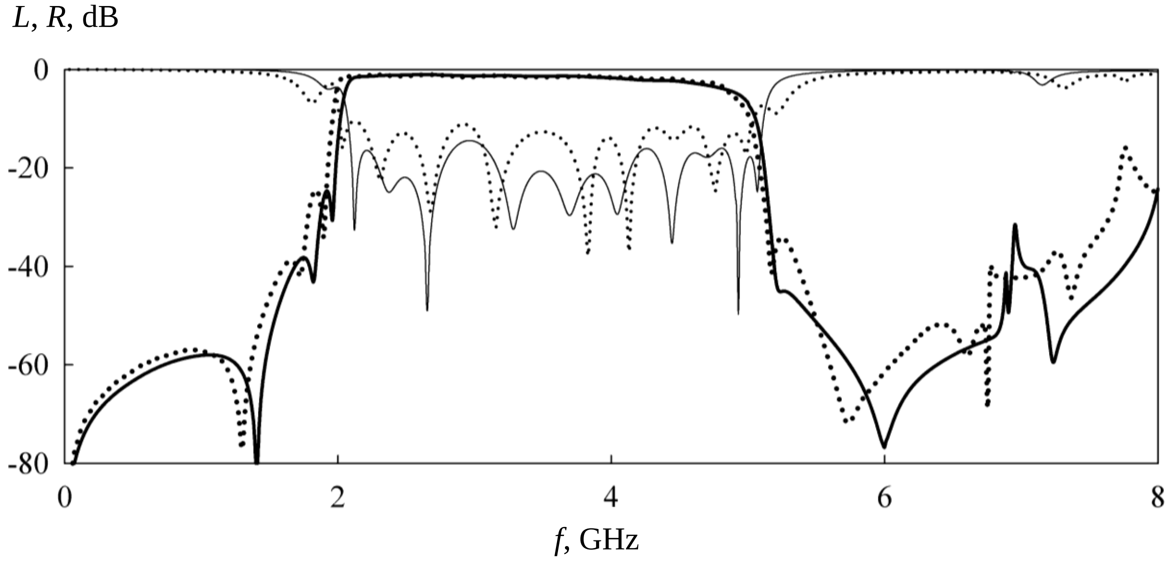

Figure 3. AFCs of microstrip wideband filter.
Lines are the calculation, and points are the measurements.

Thereby, a new structure of microstrip filter with a relative width of bandwidth $\Delta f/f_0 \approx 140\%$ is suggested. Due to the special form of strip conductors of interacting 6-mode resonator and single-mode resonators, one monitors high-frequency selective properties in the microwave device. Measurements of the test-piece of high-order filter characteristics gave good coincidence with the results of numerical electrodynamic analysis.

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