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A High-Q Low-Dimensional Resonator with Electrically Tunable Frequency

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Abstract—A low-dimensional high-Q resonator has been proposed and its frequency-response characteristics have been investigated. The specified resonator features the frequency-response characteristics that are electrically tunable by using a semiconductor diode with variable capacitance.

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Short-circuited sections of rectangular waveguides operating in the microwave range are often used as resonators. The longitudinal size of such resonator generally is equal to the dominant half-wavelength. Such resonators have low sensitivity to external inputs. The possibility of the onset of resonances in the "capacitive diaphragm–closely-spaced short-circuiter" system where the distance between the diaphragm and the short-circuiter is much less than the length of dominant wave was shown in paper [1]. The resonator of such type is convenient for building semiconductor devices, primarily due to its small dimensions and consequently due to its good packaging with other small-size semiconductor diodes.

A low-dimensional resonator with electrically tunable frequency based on the "post with a gap–short-circuiter" system was experimentally investigated by the authors of paper [2].

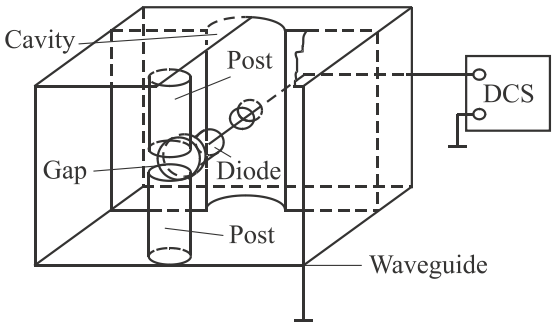

Fig. 1.

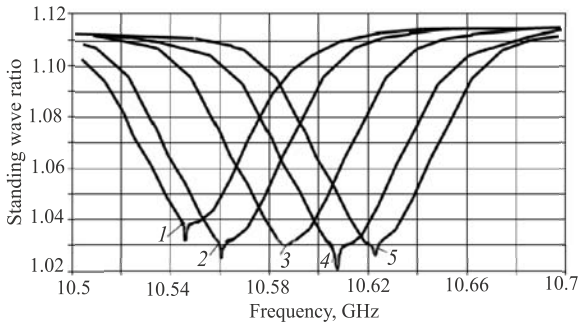

Fig. 2.

The possibility of using such resonator for creating a microwave switch based on *p*-*i*-*n*-diodes and controlled by magnetic field was shown in paper [3], while paper [4] indicated the possible use of such resonator for measuring parameters of semiconductor and dielectric materials with high resolution.

The experimental investigations of low-dimensional resonator with electrically tunable frequency based on the "post with a gap–closely-spaced short-circuiter" system [1] revealed that the resonator Q-factor in such system amounted to ~1000.

The purpose of the present study is the development of low-dimensional tunable resonators of such type featuring an enhanced value of the Q-factor.

The resonance system was investigated where the enhanced Q-factor was achieved by introducing a cylindrical cavity into the system and arranging it in parallel with the post in the central part of the short-circuiter.

The schematic of the resonator design is presented in Fig. 1. The waveguide cross-section amounts to 23×10 mm^2. A commercial diode 2A709V was mounted inside the working hole in the cavity of the