Radioelectronics and Communications Systems
Vol. 48, No. 1, pp. 40–42, 2005

Izvestiya VUZ. Radioelektronika
Vol. 48, No. 1, pp. 57–61, 2005
UDC 621.372.8

A BAND-REJECTION FILTER IN A PARTIALLY FILLED RECTANGULAR WAVEGUIDE

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The paper is devoted to investigation of a band-rejection filter, whose elementary circuit represents a segment of a partially filled rectangular waveguide with an opening in its wide wall. The structure also includes an adjacent segment of a hollow rectangular waveguide short-circuited in its end. The investigations are accomplished for the case when the dielectric plate does not come into contact with waveguide's walls.

Microwave channels of modern multi-channel communication equipment, radar and radio-navigation systems contain band-rejection filters (BRF) whose function is not to allow a signal of some frequency into the channel. When transmitting large power, it is expedient to implement microwave paths in waveguides partially filled with dielectric. Such technical decision also makes it possible to diminish the mass and overall dimensions of the microwave path. The purpose of this work is design of band-rejection filter in partially filled rectangular waveguide (PFRW).

Figure 1 shows a BRF section, which represents a PFRW segment, with a transversal opening having width l in the wide wall, and an adjacent segment of hollow rectangular waveguide (HRW) having its height L and short-circuited at one end. Metal ledges of dimension $(\Delta - l)/2$ form a capacitive diaphragm in the adjacent short-circuited segment of HRW. In essence, this segment of HRW represents a cavity resonator connected with the PFRW via this coupling opening. The short-circuited face of the HRF segment is distanced from the coupling orifice, so that local fields created near the diaphragm are not related to local fields near the end face. As can be seen from the network shown in Fig. 2, the input conductance of the short-circuited segment of HRW is defined as $Y_{\text{in}} = -\text{j}\cot\theta + 0.5\text{j}B_c$, where $\theta = 2\pi L/\Lambda$, and Λ is the waveguide wavelength of HRW while $\text{j}B_c$ is conductance of the capacitive diaphragm. The full reactive conductance Y_1 of the load, with regard for recalculation into PFRW, can be defined as [1]

$$Y_1 = (n_0 / m_1)^2 (-\text{j}\cot\theta + 0.5\text{j}B_c) + \text{j}B_1 \quad (1)$$

where

$$n_0 = \sqrt{l/\Delta}, \qquad m_1 = \int_{S_1} \left[\bar{n}\bar{E}_1\right] \bar{H}_\perp \cos\beta_{10} z \,\text{d}S,$$

$$\bar{H}_\perp = \sqrt{128/al(64 + q^2 + r^2 + q^2 r^2)}\,[Ce_1'(x,q)Ce_0(z,r)\bar{x}^0 + Ce_1(x,q)Ce_0'(z,r)\bar{y}^0],$$

$$Y_\text{d} = (aY_0/2b)\sqrt{\varepsilon_\text{eff} - (\lambda/\lambda_\text{cr})^2}, \quad \beta_{10} = k_0\sqrt{\varepsilon_\text{eff} - (\lambda/\lambda_\text{cr})^2}, \quad \text{j}B_1 = \sum_{n=1}^{\infty} n_1^2 Y_{mn},$$

$n_1 = \int_{S_1} \bar{E}_1 \bar{\varepsilon}_{mn} \text{d}S$, $Ce_0(z, r)$, $Ce_1(x, q)$ are the Mathieu even functions of the zero and first order; $Ce_0'(z,r)$, $Ce_1'(x,q)$ are derivatives of the Mathieu even functions; ε_eff is the effective permittivity [2]; λ, λ_cr are the wavelength and the critical

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25 February 2003