Coupling Coefficients of Step-Impedance Resonators in Stripeline Band-Pass Filters of Array Type

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Abstract—There are researched specificities of electromagnetic coupling coefficients at main and higher resonance frequencies between step-impedance resonators, fabricated from symmetric stripe transmission lines with open ends. It is shown, modification of step resonators parameters can result in modification of the coupling coefficient at main resonance frequency in wide range, that allows to realize band-pass filters of array type. It is stated in case of several values of parameters of stripe resonators their coupling coefficients values at frequencies higher than main one are zero. It is proposed a new method of expansion of suppressed frequency band of pass-band filters of array type, which is based on suppression of the first parasitic pass band due to zero coupling coefficient.

INTRODUCTION

Band-pass filters of planar construction (planar BPF), fabricated from microstrip and symmetric stripe transmission lines are widely applied in current-technology radioelectronic equipment [1]. BPF of array type (pseudocombline filters) contain half-wave resonators ($\lambda/2$), which are located in parallel to themselves without mutual displacement along their length.

Advantage of such filters is their compactness and absence of short-cut jump at the resonators ends. The last specificity is important in some applications, where the short-cut can hardly be realized technologically. In practice there are used array filters of microstrip construction [1–3].

Now array constructions on a basis of symmetric stripe lines are not used as BPF. They are suppressing-all circuit, since coefficients of electromagnetic coupling between adjacent $\lambda/2$ resonators are equal to zero at all frequencies [1, 4]. In this case electric and magnetic components are mutually compensated that leads to zero values of coupling coefficients. Further, for brief we use a term "stripe line" as symmetric stripe line.

In [5] it is researched an influence of parameters of step-impedance resonators with single short-cut end on electromagnetic coupling coefficient between them in case of operation at main resonance frequency. Stated in this paper regularities allowed to realize compact BPF with small thickness, whose step-impedance resonators are located close to each other with a gap of 0.1–0.2 mm.

It is advisable to study an influence of parameters of stripe step-impedance resonators with open ends on coupling coefficients between them at main and higher frequencies. In known literature sources this influence is not described yet. Step-impedance resonators with two open ends we suppose as half-wave type resonators.

In this paper it is researched an influence of parameters of step-impedance resonators of half-wave type on coefficients of electromagnetic coupling in case of application of the first three oscillations. There are stated specificities of electromagnetic coupling coefficients resulting in new method of construction of BPF of array type with expanded suppression band.

COUPLING COEFFICIENT OF STRIPLINE STEP-IMPEDANCE RESONATORS OF HALF-WAVE TYPE

Topologies of conductors of two pairs of stripeline step-impedance resonators of half-wave type are shown schematically in Fig. 1. The resonators are symmetrical with regard to their middle line axis, which is