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Stripe Delay Filters

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Abstract—There are considered constructions of microsized stripe delay filters, which are realized on a basis of ceramic materials with high dielectric permittivity. Delay time of non-minimal phase filters is 7–12 ns at frequencies of 1900 MHz with relative bandwidth of 3.6–3.85%. Filters dimensions are comparable with ones used in portable communication devices. Dimensions of researched three-resonator filter at frequency of 1900 MHz are 8.4×5×2 mm with material dielectric permittivity ε_r = 92, and 5-resonator filter ones are 9.2×8.6×2 mm. Filters are different from traditional delay filters. Two filters of considered ones contain odd resonator number and the third one contains four resonators and it has two cross couplings. The basis of the filters is amount of step-impedance stripe resonators pairs located close to each others whose electromagnetic coupling behavior is capacitive. There are represented the results of frequency characteristics simulation for different delay filters.

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INTRODUCTION

Bandpass filters with constant group delay time (delay filters) are widely applied in current-technology radio electronic devices [1]. Development of mobile communication systems, especially cellular telephony results in significant progress in direction of miniaturization **o**f different microwave bandpass filters. But the results of this miniaturization are less significant regarding delay filters comparing other ones. For example, K&L Microwave, Inc (USA) fabricates delay filter TMD-2140-80/TD with central frequency of 2140 MHz, whose dimensions are 51×23×7.4 mm [2].

Now microwave ceramic filters are characterized by minimal dimensions of filters with power level of 250 mW [3, 4]. They have amount of resonance holes and they are realized in form of monoblock from the ceramics with high dielectric permittivity ε_r = 80–100. Dimensions of three-phase filter of mentioned above frequency are not greater than 5×5×2 mm. Microwave ceramic filters are widely applied due to small size and great temperature stability of frequency. But they are restricted in functions and do not provide constant delay time.

Creation of delay filters on a basis of symmetric stripe communication lines is promising by two reasons. The possibility of application of advantages of field technology of functional elements creation allows to realize great amount of schematic solutions. Application of ceramic substrates with high dielectric permittivity allows to minimize dimension of microstripe construction filters.

In this paper it is developed and researched small-sized stripe delay filters on a basis of ceramic materials with high value of ε_r. For developing of new filters we use basic principles of delay filters theory [5, 6].

SPECIFICITIES OF STRIPE STEP-IMPEDANCE RESONATORS

We consider a pair of step-impedance resonators, whose topology is represented in Fig. 1a. One end of the resonators is short-cut, therefore we consider them as quarter-wave ones. A width of low-impedance part of each resonator is w_1, and their high-impedance part is characterized by width of w_2: $w_1 > w_2$. It is located near shot-cut end. Resonator length is L, a length of high-impedance part is l. Resonators are separated by small gap S.

Electromagnetic coupling coefficient K of two identical resonators is defined with following formula [1]