

# Synthesis and Electrodynamical Analysis of Microstrip Hairpin Filters With Slots in the Ground Plane

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**Abstract** - Analysis of microstrip pass-band filters on hairpin resonators meander shape with slots in the ground plane is presented. A simplified algorithm have been proposed for the designing of this type filters' constructions.

**Keywords** – Pass-band filter, coupled line, slots in the ground plane, hairpin resonators, center frequency.

## I. INTRODUCTION

Microstrip filters on hairpin resonator of the meander shape with a slot in the ground plane are used in radiolocation systems, radio navigation and telecommunications. The introduction of a slot in the ground plane contributes to the suppression of spurious pass-band and increasing of attenuation in the band barriers, increasing of bandpass. Also introduction of a slot allows to strengthen electrical communication between adjacent resonators and to lower requirements to tolerances.

## II. CALCULATIONS AND MODELING

The purpose of this work is to create a simplified algorithm for the designing of microstrip filters on hairpin resonators with a slot in the ground plane, realized in the Ansoft HFSS.

The filter is realized on a dielectric substrate with a thickness of 0.5 mm, a dielectric constant of 9.6 and metallization thickness of 0.005 mm. This filter is designed for use on the center frequency of 2.85 GHz, the bandwidth of 122 MHz.

To calculate the parameters of pass-band filters on hairpin resonators the method of designing coupled lines filters on the basis of low frequencies filters-prototype was used by the method proposed in [1]. The length of the coupled microstrip lines section has made 10.33 mm.

According to calculation has been designed electric circuit of the microstrip pass-band filter of hairpin resonators in the AWR Microwave Office.

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The simulated amplitude-frequency characteristic has shown a deviation of center frequency from necessary value. For elimination of this offset in system AWR Microwave Office adjustment was used by means of program Tune; owing to that the length L of a coupled lines section was decreased.

Recalculation of the geometric dimensions of the traditional microstrip pass-band hairpin filter topology at the changed length L to a topology with a slot in the ground plane was realized in the program MaxFCT. The program is based on the quasi-static analysis of microstrip topology cross-section, and a genetic algorithm to find solutions [2].

Electromagnetic analysis of the designed filter was realized in the Ansoft HFSS.

For final adjustment of the center frequency the filter's construction was optimized by a method genetic algorithm in the program Optimetrics, which is a part of the Ansoft HFSS. Length of the coupled line section and length of the slot in the ground plane has been selected as a variable for optimizing, whose value was 8.83 mm.

## III. CONCLUSION

The geometrical parameters of the microstrip pass-band hairpin filter topology with slots in the ground plane have been defined. The optimization of the coupled lines sections lengths and the slots lengths in the ground plane was provided. Simplified algorithm have been proposed for the designing of microstrip filters on hairpin resonators with a slots in the ground plane, based on electromagnetic analysis filter.

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