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Design and Analysis of Anfilplexer Multifunction Circuit for 4G Wireless Communication

A.M.Ahmed[1]
Msc Student at Ain Shams University,Cairo, Egypt

R.S. Ghoname[2]
Electronics Research Institute, Cairo, Egypt

A.EL Hennway3
Faculty of Engineering Ain Shams University, Cairo, Egypt

Abstract*— *in this paper, new design multifunction circuit, a compact microstrip antenna, microstrip filter, and microstrip diplexer (Anfilplexer) have been proposed and presented. The presented Anfilplexer structures are mounted on FR4-substrate, and the simulation result shows that both compact antenna, filter, and diplexer resonate at the same resonance frequency 5.2GHz, which can be used for 4G wireless communication applications. a compact antenna, filter, and diplexer is consisting of spiral-shaped microstrip resonators. The proposed Anfilplexer design is performed by using ready-made software package Zeland- IE3D. The Anfilplexer is fabricated by using thin film and photolithographic technique and measured by using the Vector Network Analyzer. Good agreements concordances were found between the simulated and measured results with shift 200MHz. The presented paper added a new concept for Anfilplexer design.

Keywords*— *Multifunction circuit, Antenna, Filter, Diplexer (anfilplexer), Spiral-Shaped Microstrip.

I. INTRODUCTION

in modern wireless communication system such as, mobile communication. Antenna, filter, and diplexer are among the components that are very difficult to miniaturize, as they may require the use of resonators, which are usually bulky [1]. Microstrip technology is emerged as a popular technique in realizing high-speed RF and microwave circuits. This is due to easy fabrication, relatively small size, light weight, and less cost. In addition, the compactness is a metric parameter of modern RF and microwave band–pass filters which can be achieved using dual-mode resonators. In fact, a single resonator of this kind generates a pair of transmission poles of various types and it has gained of interest. A compact microstrip antenna structure with built-in filter is very important element in wireless communication system. Such antenna is referred to as filtenna [2]. Therefore, any antenna structure that can perform radiation and filtration is an important subsystem for indoor/out-door communication systems. to achieve the 4G wireless communication system constrains. In this paper we design in 3steps antenna, filter, and diplexer in the same structure, Antenna is a structure with one port, when we add second port the structure is filter, then adding third port the structure is diplexer. The proposed Anfilplexer design is simulated at the same resonance frequency 5.2GHz. a compact antenna, filter, and diplexer consisting of spiral-shaped microstrip.The spiral shape is proposed to only effectively reduce the component size but also flexibly control the frequency band in the antenna, filter, and diplexer (Anfilplexer). This paper organized as follows. Section 2 introduces the antenna design and analysis of spiral-shaped microstrip. The compact microstrip filter design simulated with the same analysis of spiral shape are presented in section 3, and simpler analysis spiral shape design microstrip diplexer presented in section 4, compassion between the simulated and measurement result in section 5. Finally, a conclusion is given in section 6.

II. MICROSTRIP ANTENNA DESIGN

The compact microstrip spiral antenna structure is proposed, which can be used for 4G applications [3]. The compact antenna dimensions are15.66mm length and 10.84mm width. The antenna is mounted on a single FR-4 substrate (εr=4.7, 1.6 mm height, and tangential loss of 0.02) and the conductor thickness is assumed to be 0.035mm. This antenna has one port feeding with 50 ohm transmission line of length 6 mm, and its dimensions as shown in Fig.1.

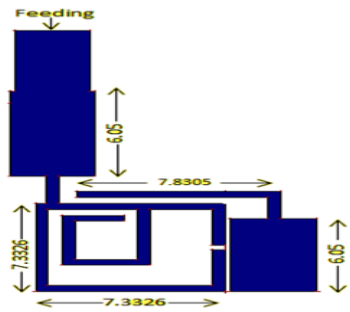


Fig. 1 Antenna geometric

a. Antenna Result Design

The compact microstrip spiral antenna design simulated at 5.2GHz shown in fig.2. In the compact antenna when stub length show in fig.3 changes then the frequency changes according to next equation,

$$L_{stub} = 169.35e^{-0.508f} \quad (1)$$

In The antenna structure shown in fig.1 when stub length 14.65mm then the wave length 2.01λ_g according to guide wave length Shown in table 1. We can control resonance frequency band and wave guide length by using the length of stub [4].

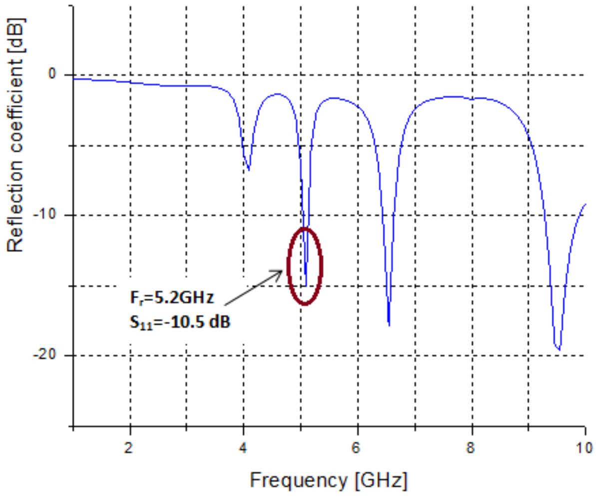


Fig. 2 |s11| of compact microstrip antenna.

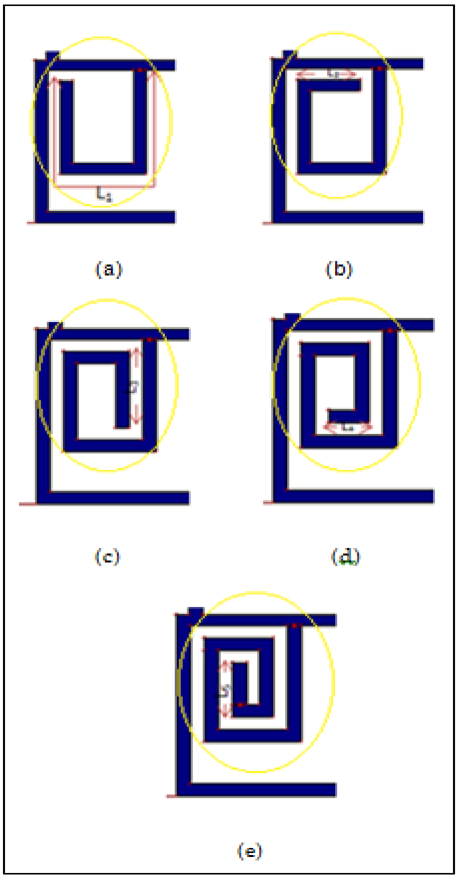


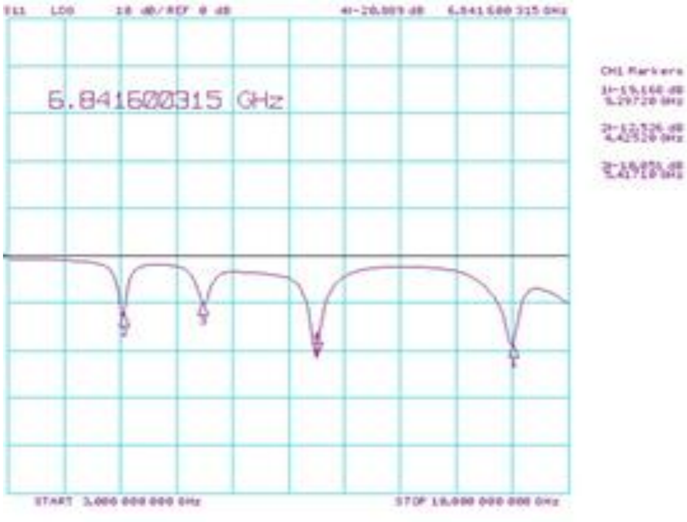
Fig. 3 Compact mirostrip stubs structure

TABLE.1

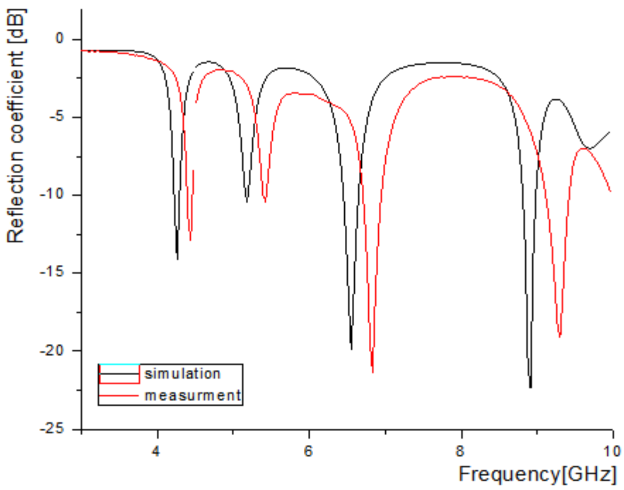
No.	Stub length(L_{stub})	Wavelength according to λ_g
a	L_1=12.22	1.87 λ_g
b	L_1+L_2=14.65	2.01 λ_g
c	L_1+L_2+L_3=17.81	2.18 λ_g
d	L_1+L_2+L_3+L_4=19.25	2.26 λ_g
e	L_1+L_2+L_3+L_4+L_5=21.41	2.38 λ_g

b. Simulation and Fabrication Antenna Result

Compact microstrip antenna simulated by using the design of Ready-made software package Zeland- IE3D and fabricated using thin film and photolithographic technique and measured using the Vector Network Analyzer. Antenna simulated and measured at 5.2GHz, with shifting 200GHz shown in fig.4.



(a)



(b)

Fig. 4 (a) Compact band pass filter measurement,
(b) Filter simulation and fabrication result.

III. MICROSTRIP FILTER DESIGN

The compact microstrip filter in communication systems has one of the most important circuit components [5]. The design of compact microstrip spiral filter structure shown in fig.5 has the same dimension of micro strip antenna. This filter has two feeding ports with 50 ohm transmission line of length 6mm.

The filter is mounted on the same FR-4 substrate (εr=4.7, 1.6 mm height, and tangential loss of 0.02) and the conductor thickness is assumed to be 0.035mm.

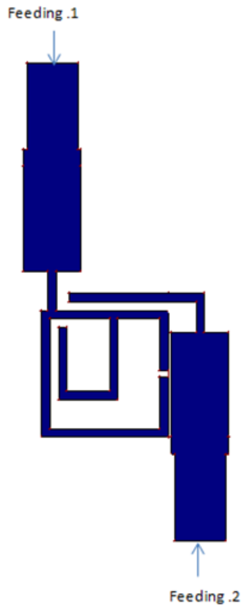


Fig. 5 Compact mirostrip filter structure

a. Filter Result Design

The compact microstrip spiral filter design simulated at same resonant frequency of compact antenna at 5.2GHz shown in fig.6. The band pass filter has two poles (-35dB and -25dB).

In the compact band pass filter we can control in resonance frequency band and wave guide length by using the length of stub. The length stub change according to the same change in the compact antenna shown in fig.3. The same analysis in compact microstrip antenna in equation(1), can be used in the same microstrip filter analysis and table.1

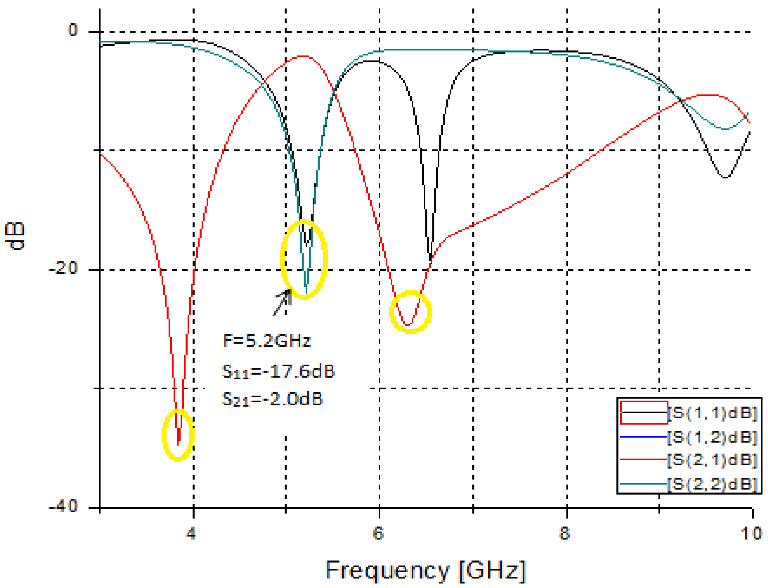
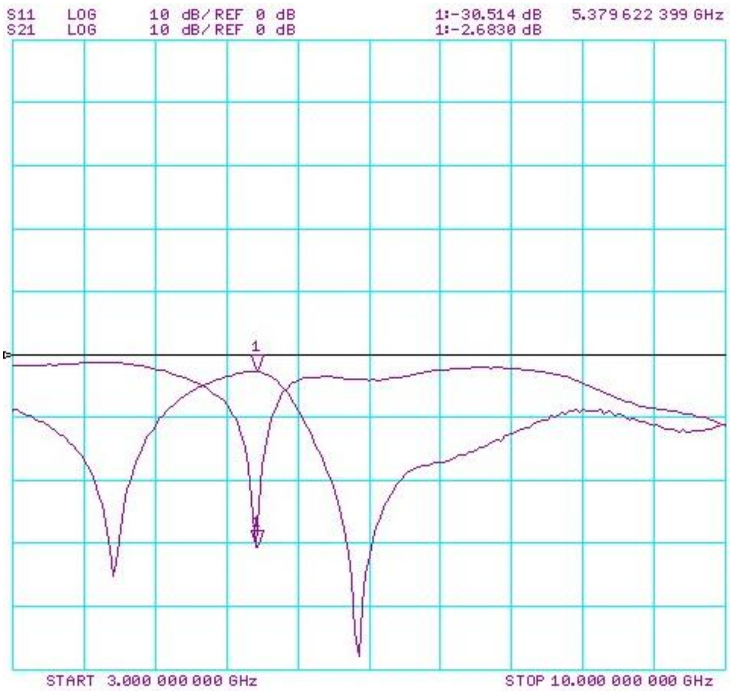


Fig. 6 |s11|,|s12|,|s21|,and|s22| of compact microstrip filter

b. Simulation and Fabrication Filter Result

Compact microstrip band pass filter simulated by using the design of Ready-made software package Zeland- IE3D and fabricated using thin film and photolithographic technique and measured using the Vector Network Analyzershown in fig.7 (a). Filter simulated and measurement at 5.2GHz, with shifting 200GHz shown in fig.7 (b).

(a)



(b)

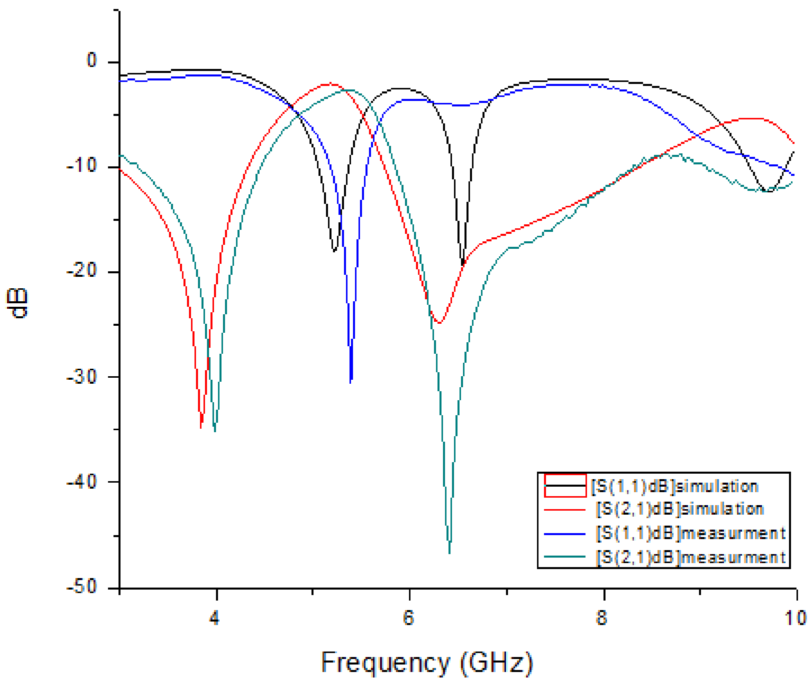


Fig. 7 (a) Compact band pass filter measurement,
(b) Filter simulation and fabrication result.

IV. MICROSTRIP DIPLEXER DESIGN

In The final step design of diplexer we used the same structure of filter and implemented design of diplexer [6]. The design of compact microstrip spiral diplexer structure show in fig.8 has the same dimension of micro strip antenna and filter. This diplexer has three feeding ports with 50 ohm transmission line of length 6mm. The diplexer is mounted on the same FR-4 substrate (εr=4.7, 1.6 mm height, and tangential loss of 0.02) and the conductor thickness is assumed to be 0.035mm.

The compact microstrip spiral diplexer design has the same band of antenna and band pass filter and the same resonance frequency 5.2GHz simulated SHOWN in fig.9. The spiral diplexer analysis in the spiral antenna and spiral filter depends on the change of stub length from equation (1) and table.1. We can control resonance frequency band and wave guide length. As shown in fig. 3 by changing the length of stub of the spiral diplexer.

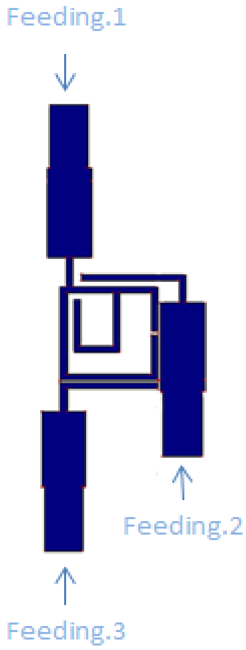


Fig. 8 Compact microstrip diplexer structure

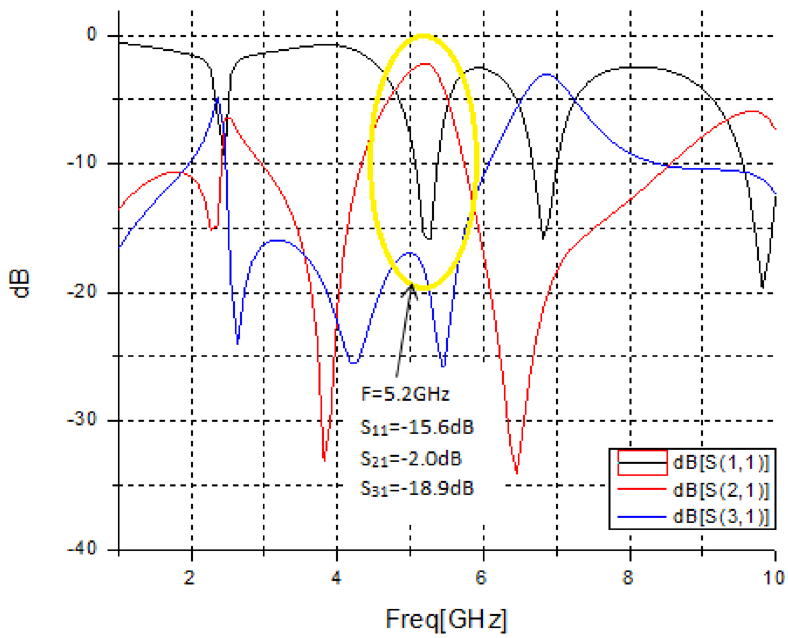


Fig. 9 |s11|,|s21|,and|s31| simulated performance of diplexer

V. CONCLUSIONS

The New compact anfilplexer structure has proposed a design which can be simulated and fabricated at the 4G. we can design the compact microstrip antenna, filter, and diplexer(anfilplexer) at the same structure with one port antenna , two port filter, and three port diplexer with same dimension and the same material mounted on FR-4 substrate (εr = 4.7, 1.6 mm height, and tangential loss of 0.02) and the conductor thickness is assumed to be 0.035mm. The measurement result shows a good agreement with the simulations but with shift 200MHz. the result of compact antenna, filter and diplexer has a same resonance frequency in simulated and fabrication. The proposed anfilplexer structures can be used for many of applications. This includes mobile wireless communication. The present paper has a new and simple method to design a planar anfilplexer and/or operates at the desired frequency bands.

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