Reconfigurable WIFI Filter with Isolation Enhancement

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Abstract— This paper presents a reconfigurable WIFI band filter with three switchable modes. Half wavelength resonators coupled with a microstirp transmission line are used to design the frequency of WIFI band. PIN switches mounted at the microstrp near the resonators are used to switch the working modes of the WIFI filter. This WIFI filter is able to work at both 2.45 GHz and 5.8 GHz with the resonators working at different modes. A dual-band band-stop mode is also available with the filter. A centrally loaded resonator technology is used to suppress the harmonic of 2.45 GHz witch would interfere the performance at 5.8 GHz. The isolation is enhanced by more than 40 dB with the structure in this paper.

1. INTRODUCTION

Due to the requirements of multifunction and multiband reconfigurable, filters are more and more important in modern communication systems [1–9]. Most of the studies are focus on center frequency tuning and bandwidths tuning or constant bandwidths, there are also some researches about pass-stop mode reconfigurable, tunable rejection levels and so on.

A tunable band-pass filter with reconfigurable bandwidth by utilized a coupling reducer [3]. Young-Ho Cho et al. presented a 0.73–1.03-GHz tunable band-pass filter with a reconfigurable multi-pole response [4]. Abunjaileh et al. also presented a tunable filter design with tunable bandwidth and center frequency [5]. A high linearity miniaturized filter at 1.4–2.0 GHz was presented by El-Tanani et al. in [6]. A RF-MEMS tunable filter by high linearity anti-biased is presented in [7]. H. Wang et al. presented a reconfigurable notch bands UWB filter with Terminated Cross-Shaped Resonators [8]. In [9] a tunable parallel resonance between two resonators is used to present a filter with enhanced rejection level and tunable bandwidths.

In this paper, a three modes reconfigurable WIFI filter with isolation enhanced is presented. PIN switches and centrally loaded resonator are used to design the WIFI filter. The design and simulation are demonstrated in the following sections. In order to test the performance of the reconfigurable WIFI filter, substrate F4B with thickness of 0.8 mm and dielectric constant of 2.65 was used in the EM simulation with Ansys HFSS.

2. DESIGN OF THE PROPOSED WIFI FILTER

In this section, the WIFI filter is designed to have a reconfigurable property with half wavelength resonator and PIN switches.

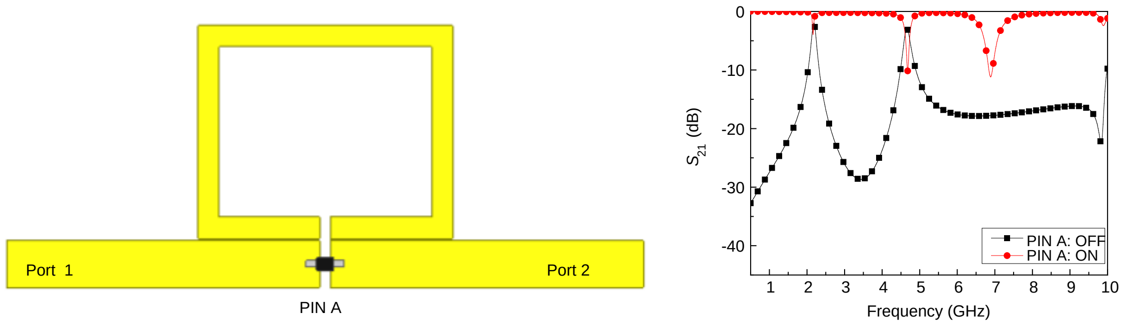
In order to make the WIFI filter compact and simplify designs, half wavelength microstrip resonators, which are very popular on planar and compact microwave circuits, are used in this design. A half wavelength resonator coupled with a complete microstrip can compose a band-stop filter by forming a transmission pole at the resonator frequency. If the microstrip is broken and coupled by the folded resonator, this structure can compose a band-pass filter by forming a transmission zero at the resonator frequency similarly. A PIN switch is used to combine and reconfigurable the band-stop and band-pass filters as shown in Figure 1. The half wavelength resonator is designed to be folded to make the structure compact.

As shown in Figure 1, the simulation shows the reconfigurable property of the structure:

When PIN A is ON, the structure is working as a half wavelength resonator coupled with a complete microstrip. So, the structure is a band-stop filter.

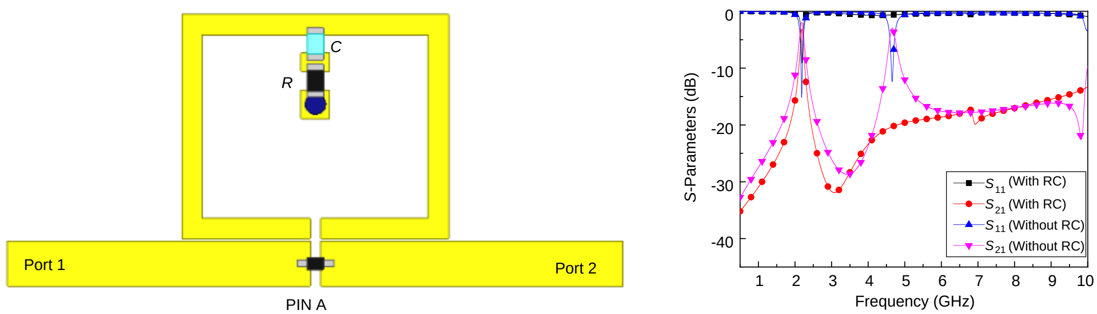
When PIN A is OFF, the structure is working as a half wavelength resonator coupled with a broken microstrip. So, the structure is a band-pass filter.

The properties shown below is very interesting. If a 5.8 GHz similar structure is cascaded, its working mode can be controlled by setting the status of the PIN switches. Especially, when the two PIN switches are set different status, the isolation will be enhanced by each other. For example, if the 2.45 GHz PIN switch is ON, and the 5.8 GHz PIN switch is OFF, it is a 5.8 GHz filter, on the same time, the channel of 2.45 GHz is protected by working as a band-stop filter.



(a) (b)

Figure 1: PIN switch working performance (2.45 GHz). (a) Reconfigurable cell with a half wavelength resonator and a PIN switch. (b) The performance of the PIN switch at ON and OFF modes.



(a) (b)

Figure 2: Harmonic suppression (RC: centrally loaded resistor and capacitor). (a) Reconfigurable cell utilized centrally loaded resonator. (b) The result of the harmonic suppression.

However, there is harmonic near 5.8 GHz forming by the 2.45 GHz resonator. The harmonic will decline the performance of a system. Therefore, a centrally loaded resonator is utilized to suppress the interference [11].

The harmonic is caused by the even mode of the resonator by an odd and even mode method. The even mode of a centrally loaded half wavelength resonator will be reflected and absorbed by the loaded resistor and capacitor, as shown in Figure 2, so as to be suppressed.

Figure 2 shows the structure and results of a reconfigurable cell with centrally loaded half wavelength resonator: the harmonic is vanished obviously. The harmonics of 5.8 GHz cell will no influence the 2.45 GHz cell, so, it is no necessary to design a centrally loaded resonator for 5.8 GHz.

3. SIMULATION RESULTS OF THE WIFI FILTER

In this section, the simulation results of a reconfigurable WIFI filter cascaded with a centrally loaded 2.45 GHz cell and a normal 5.8 GHz cell is described.

The proposed reconfigurable WIFI filter and simulation are shown in Figure 3: Resonator A works at 2.45 GHz and Resonator B works at 5.8 GHz. C0 is used to block DC caused by the Biases of the two PIN switches.

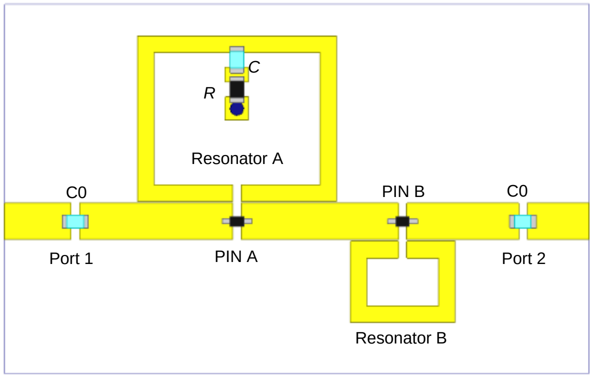
The reconfigurable properties can be seen as:

When PIN A is ON, and PIN B is OFF: 2.45 GHz cell is a stop band at 2.45 GHz and pass band at 5.8 GHz, 5.8 GHz cell is a stop band at 2.45 GHz and pass band at 5.8 GHz. It is working as a band-pass filter at 5.8 GHz with an isolation of more than 40 dB at 2.45 GHz.

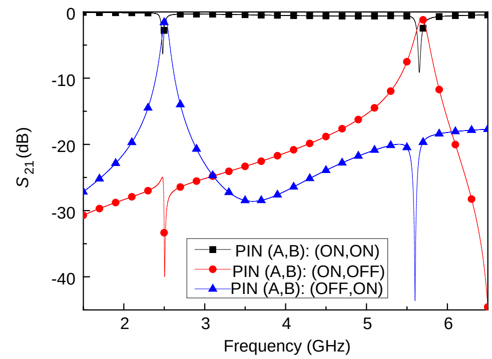
When PIN A is ON, and PIN B is OFF: similarly, it is working as a band-pass filter at 2.45 GHz with an isolation of more than 40 dB at 5.8 GHz.

When PIN A is ON, and PIN B is ON: 2.45 GHz cell is a stop band at 2.45 GHz and pass band at 5.8 GHz, 5.8 GHz cell is a pass band at 2.45 GHz and stop band at 5.8 GHz. It is working at dual-band band-stop mode.

When PIN A is OFF, and PIN B is OFF: similarly, it is working at dual-band band-stop mode, however, its performance is bad than (ON, ON) status.



(a)



(b)

Figure 3: Simulation results of the proposed WIFI filter. (a) Reconfigurable WIFI filter. (b) The three working modes of the WIFI filter.

It is also can be seen that when the PIN switches shift their modes, the frequency will have a slight shift, which will limit the usage of the WIFI filter.

4. FUTURE WORK

The proposed WIFI filter can utilize varactors to resolve the problem by make the filter be continuously tunable. And it will combine mode shift at 2.45 GHz and 5.8 GHz and part continuously tunable at each frequency is more promising in WIFI systems.

5. CONCLUTION

In summary, a reconfigurable WIFI filter with three modes: dual-band band-stop filter, band-pass at 2.45 GHz and 5.8 GHz with a more than 40 dB protection at counterpart is proposed in this paper. A centrally loaded resonator is utilized to suppress the harmonic produced by the even mode of the normal resonator. It is very promising to using in modern WIFI systems.

ACKNOWLEDGMENT

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