Design of an Ultra-Wide Band Planar Antenna with Triple Band-Notched Characteristics

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Abstract:

In this paper, we are proposed an ultra wide band antenna. The ultra wide band is operated from 3.1 to 10.6 GHZ approved by the Federal Communication Commission (FCC) in 2002. The antenna consists of complimentary split ring resonator(CSRR) structure and split ring resonator(SRR) structure and EBG Structure in the ground plane are used to achieve 4.10/5.90/7.42GHZ triple band notched characteristics. The measured result shows that the proposed antenna can achieve the voltage standing wave ratio (VSWR) requirement of less than 2.0 with triple band –rejection performance of 3.7-4.2GHZ, 5.1-6.19GHZ and 7.2-7.7GHZ.

Key Words:

Split Ring Resonator(SRR) structure, triple-band notched performance, Complementary Split Ring resonator (CSRR) structure, UWB antenna.

Introduction:

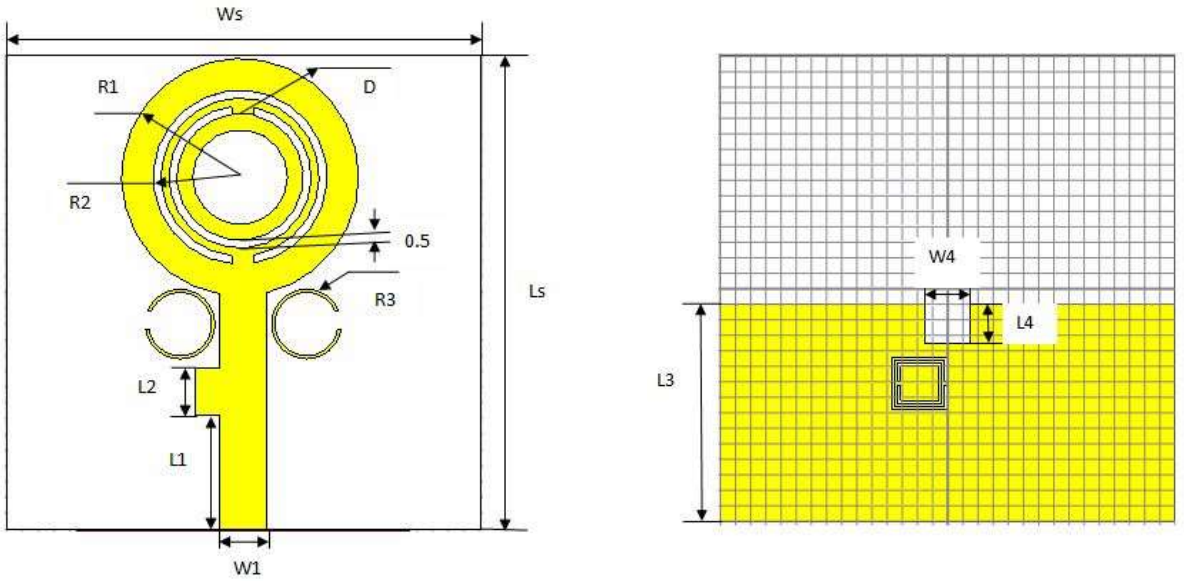
In this article, Ultra Wide band planar antenna is designed with c & inverted c-shape on annular path and SRR slots and EBG slot on ground plane to generate 3.7-4.2 and 5.1-6.19 and 7.1-7.7GHz is achieved respectively[1-2]. The CSRR method is proposed because it has property of negative effective permittivity[3]and can be used to reject unwanted frequencies. Here from these annular patch we can generate triple –band notch's are obtained and since from past few years, various techniques has been came into existence but most of the antennas are able to generate only one notch but these design is made to generate more than three notch-bands. Moreover the triple band notched performance can be varied by adjusting the values of c shape slot and SRR dimensions and CSRR dimensions.

The UWB antennas plays an important role in recent years due to its advantages like high channel capacity, security, reliable data, low transmission power consumption. In 2002 ,Federal Communication commission approved that over the commercial frequencies from 3.1 to 10.6GHz[4].Due these attractive and useful merits with UWB system the technologies are moving towards these narrow-band systems.

The proposed antenna can be used for various applications as X-band satellite applications and to achieve the frequency as 7.17-7.71GHZ by using the slot as a SRR[5-7] structure placed in a substrate. And for the C-Band system applications the achieve the frequency as 3.7-4.2GHZ by using the slot as circular CSRR[8-10] structure in the patch. The final application for the proposed antenna is WLAN application[11-12] ,the frequency range for this application is 5.1-6.19GHZ is achieved by introducing slot as EBG structure in the ground plane.

Antenna Design:

Schematic configuration of the proposed antenna is shown in figure 1 .the antenna is designed using copper and FR-4 materials. Copper is used to design the ground plane and the conducting patch on the substrate while FR-4 is used to design the substrate. We consider the 15x15x0.035 mm^3 for ground. For substrate we used 15x15x1.6 mm^3.the relative permittivity of the substrate is 4.4. For patch the thickness is 0.035 mm . A rectangular notch with size of 3mm×2.5mm on the top of the ground is proposed to improve impedance bandwidth of the presented antenna. The center of CSRR has been displaced by 1.5mm from the center of the microstrip.



Top View **Bottom View**

Figure1

Ls:Length of substrate=30mm

Ws:Width of substrate=30mm

R1:Radius of circle1=7.5mm

R2:Radius of circle2=5.5mm

R3:Radius of circle3=2.2mm

D:Distence between the end to end=1.7mm

L1:Distence between Ground to chip=7.8mm

W1:Width of the feeding=3mm

L2:Length of the chip=3mm

L3:Length of the Ground plane=14mm

L4:Length of Ground chip=2.5mm

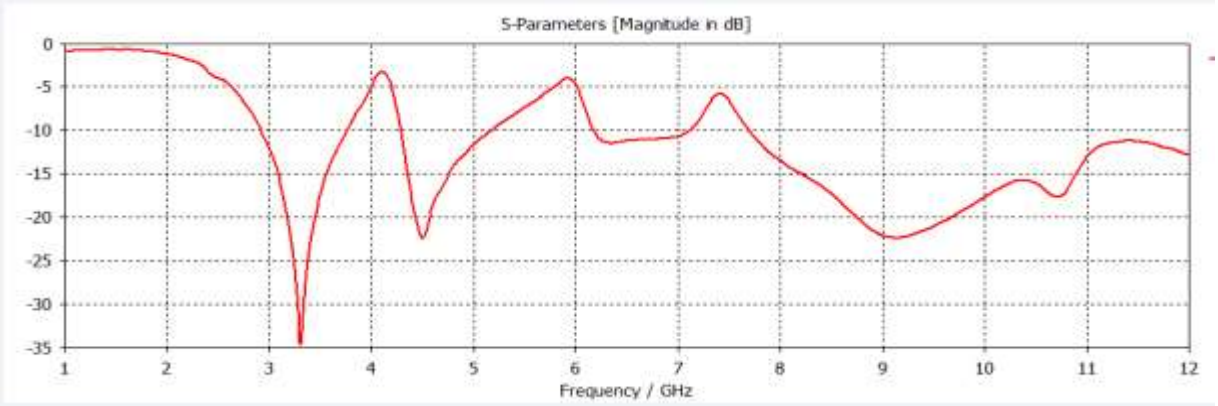
W4:Width of Ground chip=3mm

Results And Discussion:

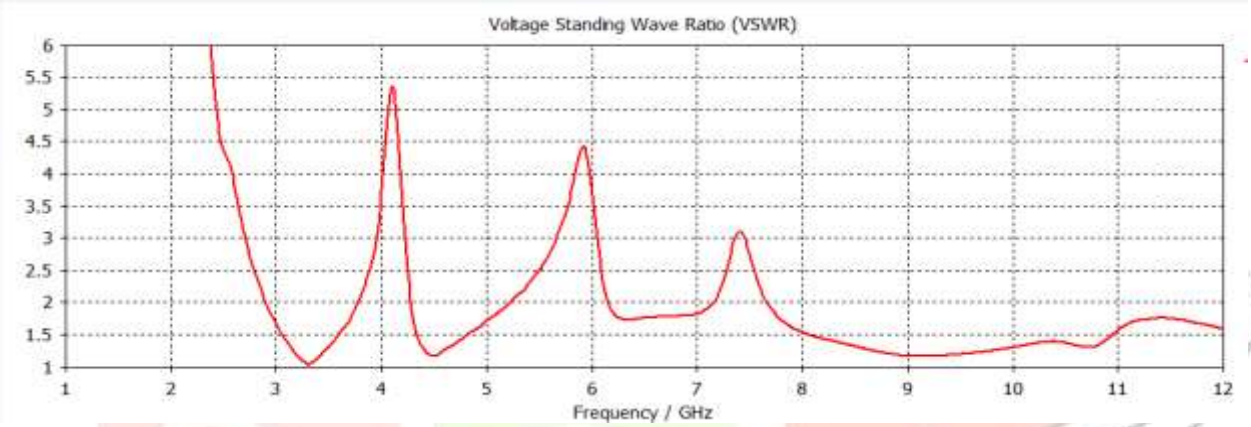
This antenna was developed by using CST microwave studio 2017 to perform simulation and optimization process and also to measure VSWR and return losses with accurate range can be possible with the help of these studio. The S- parameters are shown in figure2, the VSWR are shown in figure3. And the radiation pattern also obtained using these software without any changes to radiated frequencies ranges.

Here the triple band notches which are above 10db and having above 2.0 with good performance of successful rejection bands of 3.7-4.2GHZ, 5.1-6.17GHZ and 7.17-7.71GHZ

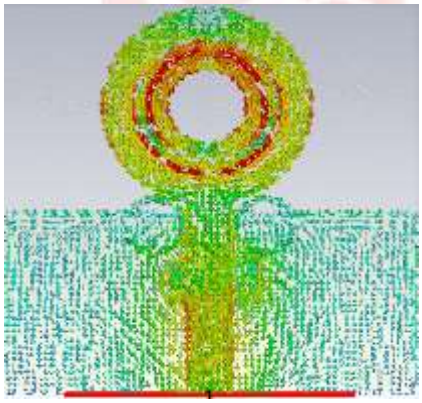
S-Parameters:



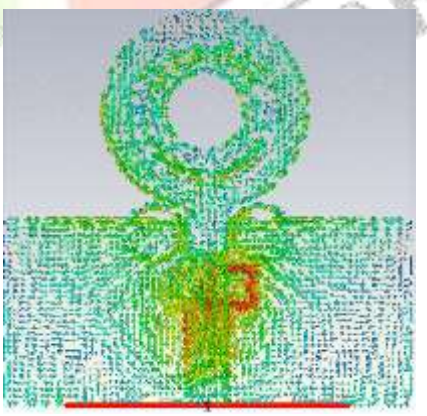
VSWR:



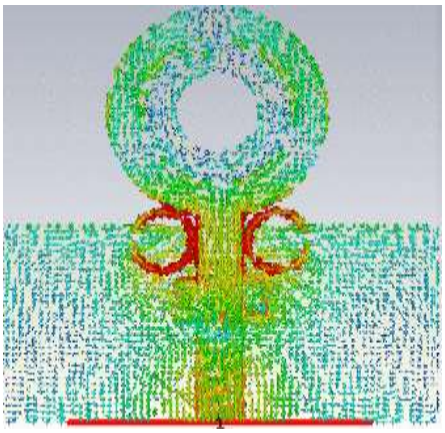
Surface currents:



Surface current for 3.7-4.2GHZ



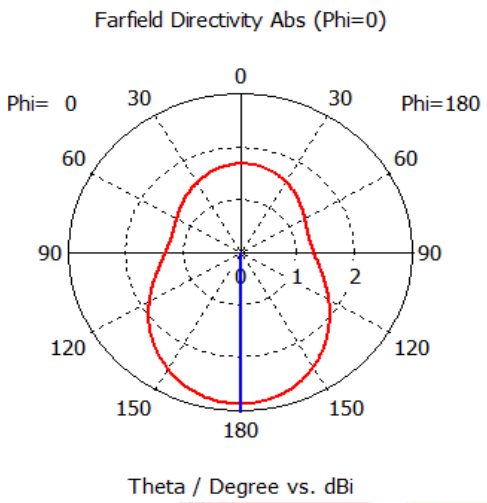
Surface Current for 5.1-6.19GHZ



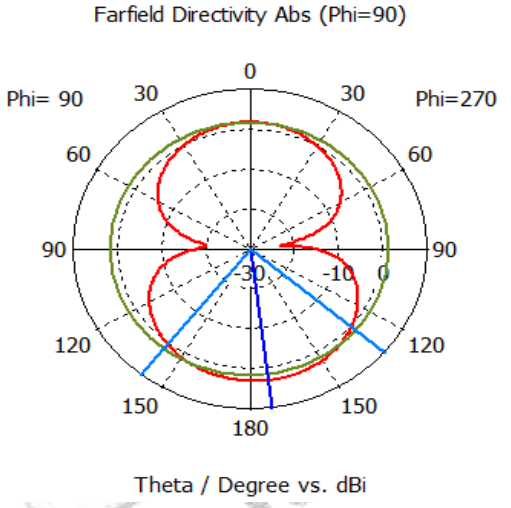
Surface Current for 7.17-7.71GHZ

Radiation Pattern:

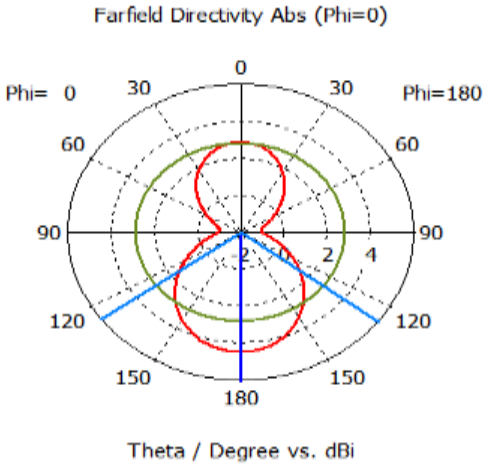
Radiation Pattern in E-field at 3.31GHZ



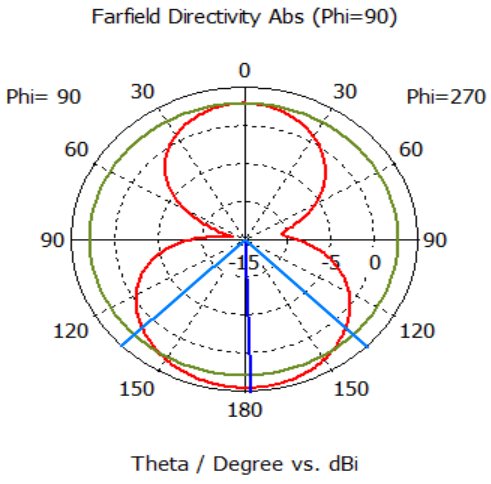
Radiation Pattern in H-field at 3.31GHZ



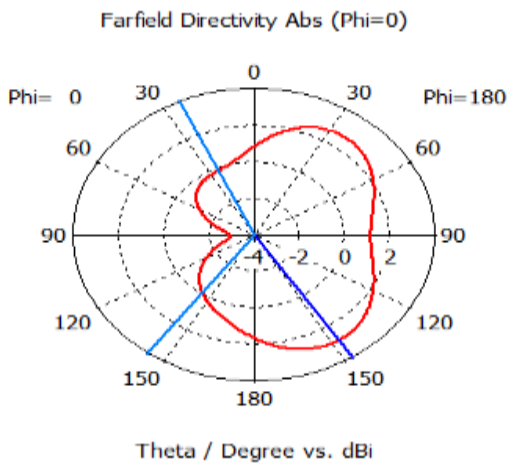
Radiation Pattern in E-field at 4.10GHZ



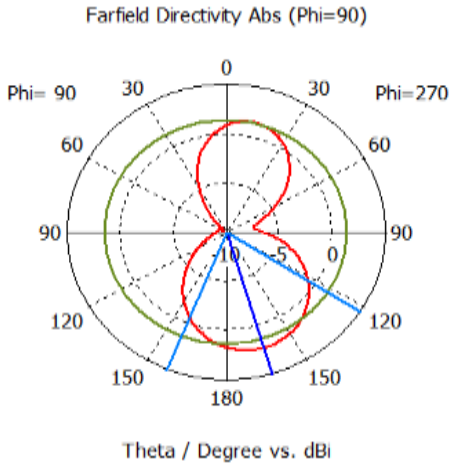
Radiation Pattern in H-field at 4.10GHZ



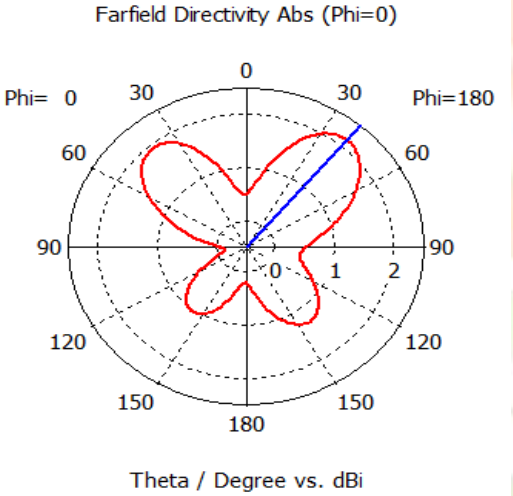
Radiation Pattern in E-field at 5.9GHZ



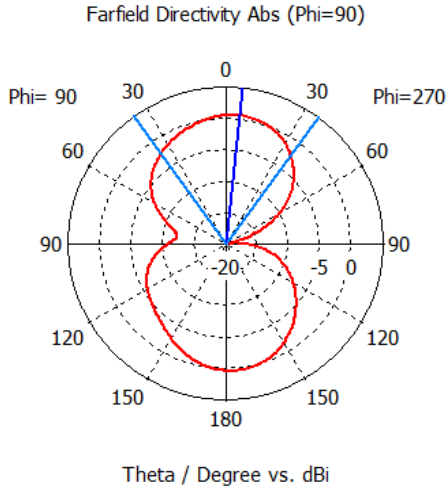
Radiation Pattern in H-field at 3.31GHZ



Radiation Pattern in E-field at 7.41GHZ



Radiation Pattern in H-field at 3.31GHZ



Conclusion:

In this paper, an UWB planar antenna is designed to operate at a triple-band notched performance of 4.10GHz, 5.90GHz and 7.42GHz. The developed antenna is used for various applications due to its narrow band performance and better VSWR range. The important antenna parameters like S-parameters, VSWR, surface current and radiation pattern of the developed antenna are presented. The developed antenna can be used for applications such as for satellite communications, C-band systems, WLAN systems.

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