KIET IJCE KIET International Journal of Communications & Electronics
Volume. No. 6, Issue No. 1, Jan-June 2018, ISSN: 2320 – 8996

Dual Band Microstrip Patch Antenna with Complementary Split Ring Resonator (CSRR)

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ABSTRACT

Dual band multiband microstrip patch antenna based on complementary split ring resonator (CSRR) is presented on the paper. Dual band is achieved by etching CSRR at the ground plane. The antenna is working at frequencies 6.3 GHz and 7 GHz. The antenna has a application in wireless frequency.

***Keywords*:** Microstrip patch antenna, dual band, CSRR, antenna , wireless frequency

INTRODUCTION

Microstrip antenna also called as a printed antenna means an antenna fabricated using microstriptechniques on a printed circuit board (PCB) [1] . It is a kind of Internal Antenna.They are mostly used at microwave frequencies. An individual microstrip antenna consists of a patch of metal foil of various shapes (a patch antenna) on the surface of a PCB(printed circuit board), with a metal foil ground plane on the other side of the board. Most microstrip antennas consist of multiple patches in a two-dimensional array. The antenna is usually connected to the transmitter or receiver through foil microstrip transmission lines. Various antenna based on microstrip antenna is designed using rectangular patch antenna working in different frequencises range.

Use of metamaterials for antennas is one of the most important applications currently being investigated. Split-ring resonator (SRR) and its dual, complementary splitring resonator (CSRR) have been the popular resonators which are widely used to synthesize metamaterials [2-3]. CSRR's have been proven to exhibit negative permittivity and permeability. Their applications to miniaturize microwave devices and various antennas were widely investigated and presented.

The paper present a dual microstrip patch antenna based on CSRR. Dual band is achieved by placing CSRR at the lower edge of antenna. The antenna is designed on FR4 substrate having height 1.54mm with thickness 1mm. The antenna is designed on Ansys software.

ANTENNA DESIGN

A microstrip patch antenna with CSRR is designed as shown in Fig.1. It consists of a rectangular patch placed on a substrate with ground plane at the bottom. The substrate is 1.5 mm thick and has relative permittivity of 4.4 and loss tangent 0.0025. When this antenna is excited by a microstrip feed, it radiates EM energy in the vertical direction due to formation of fringing fields around the patch slots.

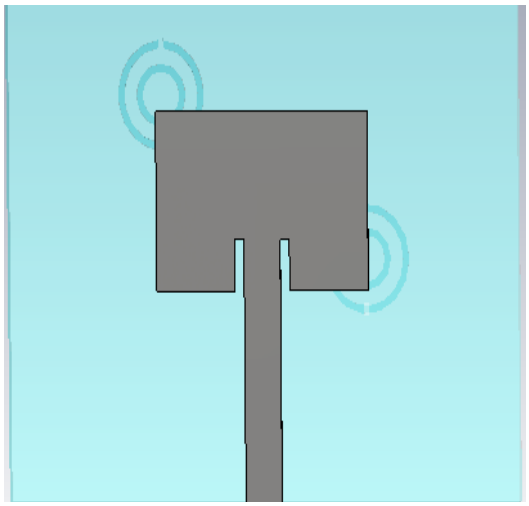

Fig.1Microstrip patch antenna design with dimensions Ls=52mm, Ws=40mm, Lp=16.01mm, Wp=22.7mm and ts=2.54mm.

CSRR Design.

Fig.2 shows a CSRR with a microstrip line on the other side. CSRR exhibit simultaneously negative permittivity and permeability for the respective frequencies bands. CSRR at the ground change the current distribution and hence the antenna operates at two frequencies.

Microstrip Loaded with CSRR

Fig.1 shows the microstrip antenna loaded with two CSRR at the ground plane. The two complementary split ring resonator will change the overall the current distribution due to negative paermeability and hence the effective parameters of the structure. The capacitance and inductance of the CSRR will overall change the resonance of the structure.

RESULTS AND DISCUSSION

Return Loss

The S parameter for the proposed antenna is shown in figure Fig.2. the figure shows the dual band behaviour of the microstrip patch antenna loaded with CSRR. The return has S11<-10 dB which shows good impedance matching.

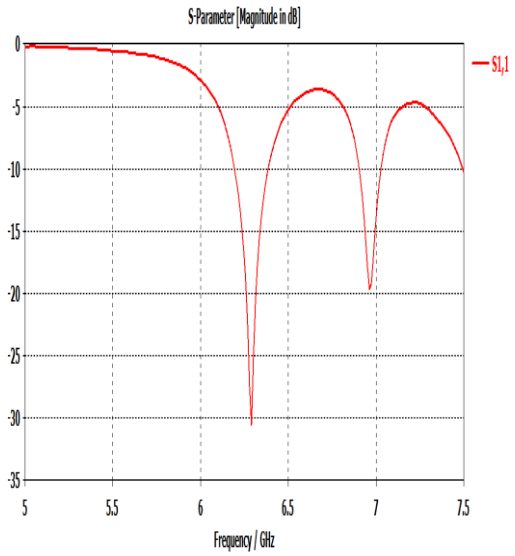

Fig.2 Return loss of the proposed antenna in dB showing two cutoff frequencies (Dual Band) at 6.3 GHz and 7 GHz

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Current Distribution

The current distribution for the antenna is shown in fig.3. The current distribution is calculated for both of the frequencies of the antenna i.e. 6.3 GHz and 7 GHz.

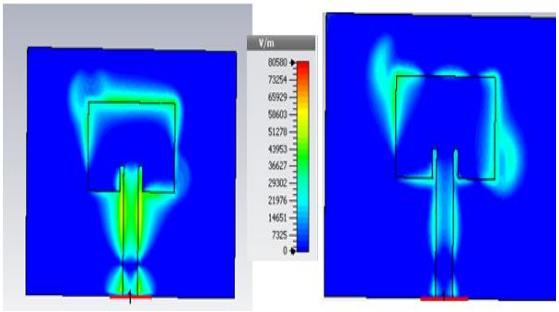

Fig. 3Current Distribution for proposed antenna at 6.3 GHzand 7 GHz frequencies

Radiation Pattern

The radiation pattern for the bow tie substrate integrated antenna is shown in fig.4. The antenna is radiated in both of the direction with a high gain at both the frequencies. The pattern demonstrated for the antenna is in broadside direction with a gain of 7.23 dB at 6.3 GHz and 5.12 dB at 7 GHz. The antenna has an application in wireless application.

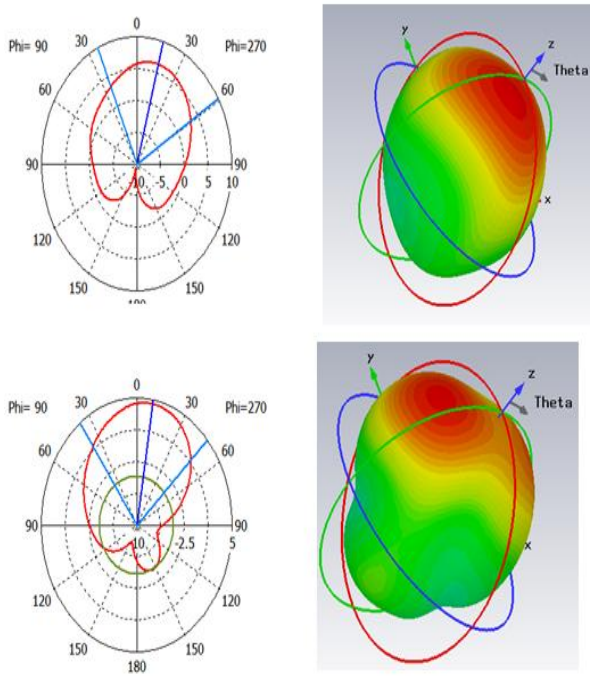

Fig. 5. Radiation Pattern of the proposed antenna at (a) 6.3 GHz and (b) 7 GHz

CONCLUSION

The paper present a dual microstrip patch antenna based on CSRR. Dual band is achieved by placing CSRR at the lower edge of antenna. The antenna is designed on FR4 substrate having height 1.54mm with thickness 1mm. The antenna is designed on Ansys software. The

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