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TRIANGULAR SHAPE ANTENNA LOADED WITH META MATERIAL AND BACKED WITH METASURFACE

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Abstract:
A compact and robust antenna is incorporated with metamaterials (MTM) operating at three frequencies of 1.9GHz,2.9GHz and 5.4GHz is introduced and designed where the MTM behaves as Electromagnetic Band gap(EBG) or Artificial magnetic conductor.The MTM with antenna achieved a Gain of 8.4183dB and the Bandwidth of 246MHz,83MHz and 57.9MHz and the VSWR is of with reflector is 2.9,4.0 and 4.6 for resonance frequency of 1.9GHz,2.9GHz and 5.4GHz .The benefit of introducing MTM in an antenna is to diminish the influence of frequency detuning and reduces the backward radiation and also to improve the characteristics of antenna. Further-more, the integrated design has the capability of controlling and improve Bandwidth, Gain, Front to back Ratio. The measured results are in good agreement with simulated ones.
Keywords: Micro strip antenna, circular polarization, impedance bandwidth, axial ratio bandwidth

I. INTRODUCTION

Microstrip antennas have been popular for decades because they exhibit a low profile, small size, lightweight, conformity, low manufacturing cost, high efficiency and an easy method of fabrication and installation. However, patch antennas have a main disadvantage:narrowbandwidth. Researchers have made many efforts to overcome this problem and many configurations have been presented to extend the bandwidth. Meanwhile, with the rapid development of monolithic microwave integrated circuit （MMIC）, wideband wireless communications, phased antenna array systems, and power combiners. An appropriate antenna with circular polarization, simplicity in construction and miniaturization has attracted many researchers attention. In [1], authors presented a tooth-like-slot patch. This patch is electromagnetically coupled by a microstrip feed line. In addition to the easy feeding, the proposed structure possesses the advantages of being bandwidth. In [2], multiple resonances of a single layer probe fed wideband microstrip U-slot patch antenna are discussed. Results show that the radiation characteristics, such as polarization and gain, are modified within the bandwidth owing to the excitation of resonant modes orthogonal to each other.
In [3], a dual-polarized shorted bowtie antenna integrated with a cross dipole is presented. The antenna yields good radiation characteristics and a wide frequency band. In [4,5], metamaterials are constructed by connecting different elements which are claimed from composite materials like metal or plastic. The materials are arranged in periodic pattern at ranges that are less than the wavelength of the phenomena that they influence. In [6], Meta-materials are the materials whose definite properties are depending on the internal structure of the material it

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is composed instead of not depending on the matter of which they composed. It is possible to combine the small elements called unit cells to form a material which is suitable to meet the required features. Before the emergence of meta-materials, propagation of wave through the medium was explained as a static property of the materials similar to the colour of the material or hardness of the material.In [7], a simple technique is developed to improve the axial ratio (AR)-bandwidth and quality of circularly polarized stacked microstrip antennas using a new C-type single feed. The antenna has a 3 dB AR bandwidth of 13.5%. In [8], a dual circularly polarized, wideband microstrip antenna fed by two perpendicular crossed slots is analyzed. The cross shaped aperture in the ground plane provides coupling between the microstrip patch and a single microstrip line underneath the ground plane. In [9], authors presented a new technique to reduce the overall dimension of a microstrip antenna using a partially filled high-permittivity substrate. In [10], a novel miniaturized quarter wavelength, H-shaped antenna which will find applications in monolithic microwave integrated circuit (MMIC) design is presented. The antenna occupies approximately one tenth of the substrate area of a half wavelength patch antenna. However, these methods typically enlarge the antenna size, either in the antenna plane or in the antenna height. Thick substrates lead to higher dielectric loss and the emergence of surface waves which degrades the antenna radiation pattern and reduces radiation efficiency. Other proposed designs usually suffer from complex fabrication processes. Due to these reasons, single-patch low-profile wide-band CP antennas have attracted many researchers' attention. Compared to previous mentioned microstrip patch antenna designs, the familiar bowtie patch antenna with T-shaped feedline is simpler in construction and offers even more enhanced characteristics

II. ANTENNA CONFIGURATION

It consists of two triangular split ring resonators and a co-planar wave guide (CPW). "FR4_EPOXY" is used as a substrate for antennas whose relative permittivity is 2.2. The overall dimension of substrate is 40 × 40 × 1 mm3. The designed antenna works for various applications like Mobile Satellite Service(MSS),WIMAX, Airport Surveillance Radar and S-Band applications. This antenna design is simulated using ANSOFT HFSS.

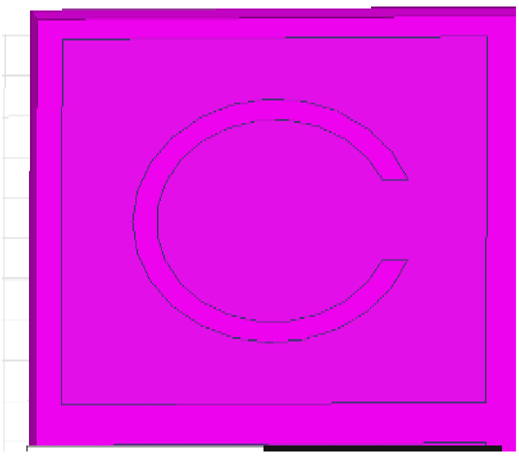


fig1:meta surface unit cell of SRR.

Fig. 2.Antenna configuration proposed with reflector

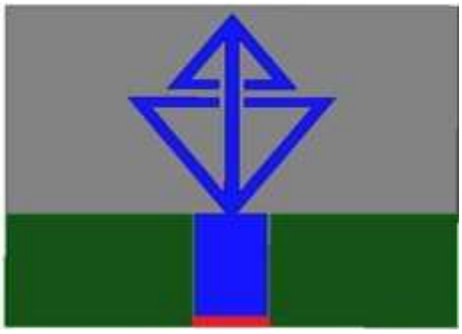


Fig.3 Schematic diagram of the proposed antenna patch without reflector

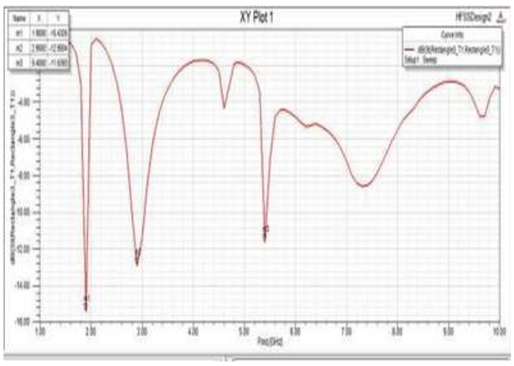
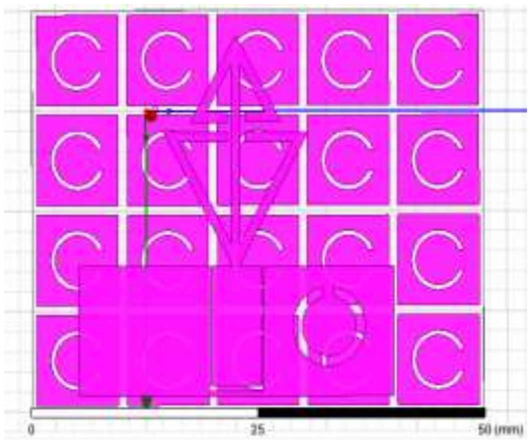


fig 4:fabricated antenna with reflector

The Schematic diagram of the proposed antenna patch with detailed dimensions are

PARAMETERS	DIMENSIONS (mm)
lg	14.5
wg	13
wf	5.5
gf	0.2
a1	16
a 2	10
g	2
w	1
D	1
R1	3
R2	4
G	1.2



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III. RESULTS

Simulations and Measured results were conducted on the proposed patch antenna using Ansoft HFSS and with Network Analyzer, its return loss characteristics are presented in Fig.5 and shows that Here above S-parameter plot shows that this antenna is operating at a frequencies of 1.9GHz, 2.9GHz, 5.4GHz

Fig.5Simulated result of Return loss characteristics of patch antenna

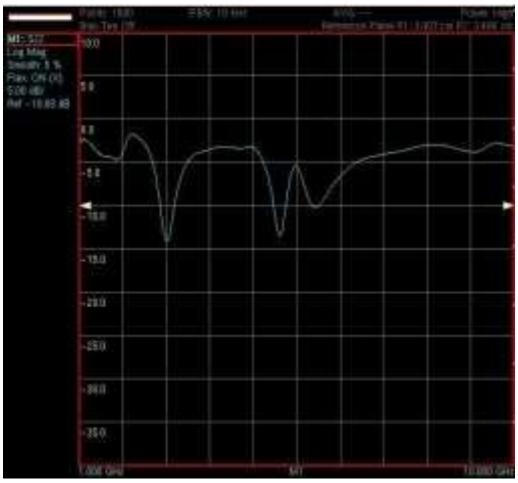

Fig.6Measured result of Return loss characteristics of patch antenna

the VSWR(voltage standing wave ratio) plot for the Metamaterial triangular shape antenna of VSWR with values of 2.9,4.0,4.6 with reflector of metamaterial

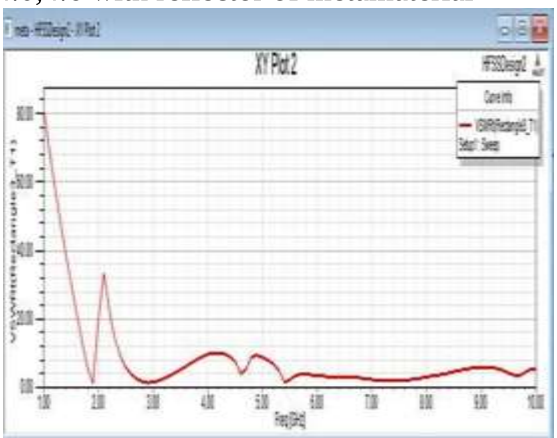

Fig.7Simulated result of vswr plot of the antenna

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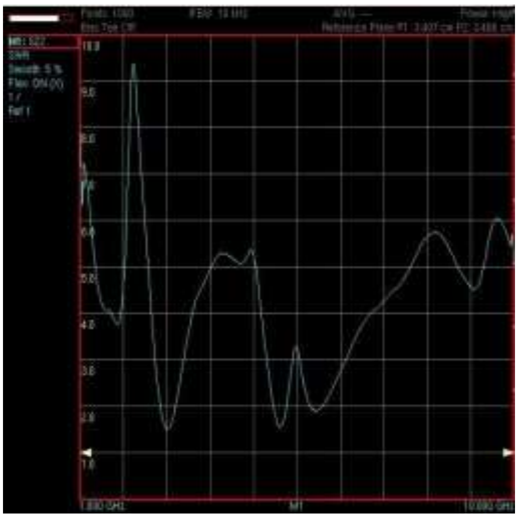

Fig.8 Measured result of vswr plot of the antenna

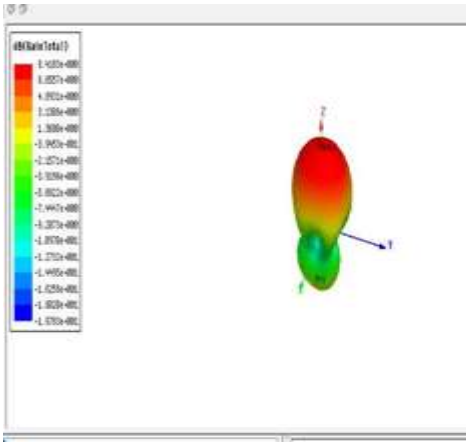

Fig.9 gain in 3-d

The peak gain values of metamaterial Triangular shape antenna with 8.4183db

IV. CONCLUSION

A robust and low profile integrated antenna with MTM is effectively studied in free space at a frequency of 1.9GHz ,2.9GHz,5.4GHz. The MTM design is employed to eradicate the frequency detuning and backward radiation. The integrated antenna with MTM design shows good and consistent S11 values (<−10 dB) .The antenna with MTM achieved a gain of 8.4183 dB and with an impedance bandwidth of 4.2473%,8.448% and 1.0425%at the desired frequency of 1.9,2.9 and 5.4GHz. Hence, the introduced antenna design has high potential .

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