Stepped V-shaped Multiband Printed antenna with AMC

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Abstract

A CPW feed Stepped V-shaped Multiband Printed antenna with AMC is shown in this work. On an FR4 substrate with dimensions of 25x25x1.6mm^3, the structure is created. The suggested antenna has been constructed and measured. The antenna covers the triple bands of 3.4GHz-5.86GHz, 10.28GHz-11.86GHz, and 13.69GHz-14.28GHz and resonates at 4.6/11/13.9GHz.The Simulated gains, radiation patterns, and S11 results arepresented. . The key characteristics of the suggested antenna include its simple design, steady radiation pattern, multiband operation, suitable gain, and effectiveness.

Introduction

Due to the rapid advancement of integrated and multipurpose wireless communication systems, multiband antennas are frequently needed to cover various operating frequency bands. Triple bands and dual-bands are possible [1], four bands [2], and penta bands [3-6], certain practical techniques have been established. Slots [7], monopole arms [8], defected ground structure (DGS) [9, 10], etching slits [11], L-shaped notch [12], parasitic element [13], and rectangular slot [14] are just a few of the techniques that can be found in the literature.

The representation of everything that is frequency-based is done using complex permittivity and permeability.The behaviour of the material in the electromagnetic environment will be determined by these characteristics.Left-handed (LH) materials are another name for metamaterials that exhibit negative permittivity and permeability. To obtain the desirable EM properties needed for a variety of applications, several electromagnetism (EM) researchers change the properties of LH materials [15–16]. These metamaterials (MTM) feature intriguing electromagnetic (EM) properties that are undoubtedly absent from nature. MTM offers increased adaptability for obtaining a number of EM phenomena and inspires structures with one or more unit cells.

However, every piece of research that has been published the literature contains a complex structure, an odd radiation behaviour, and a limited number of bands in use.

1. Antenna Design

An antenna and an AMC are the two components of the design. The sections below show the design process as well as an analysis of both portions. This model uses a substrate when copper is used for the patch elements and FR4..

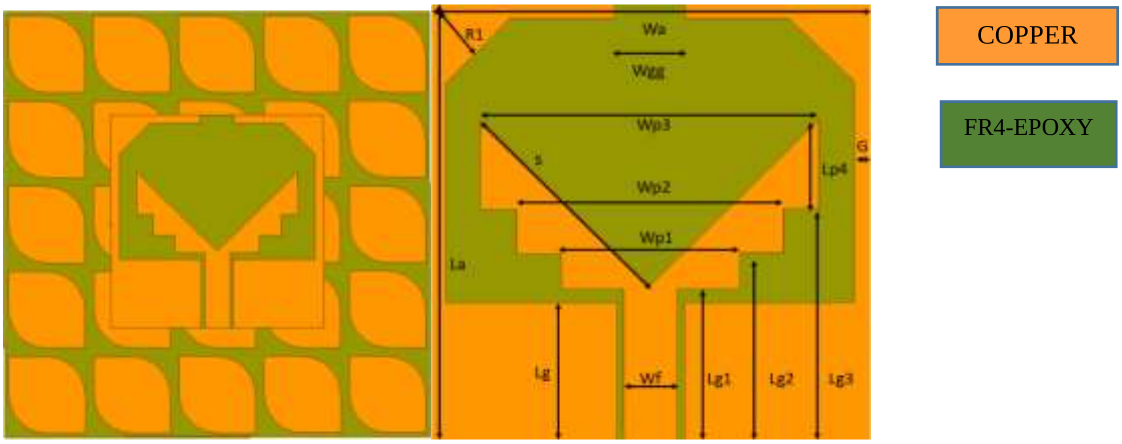

Figure 2.1 Proposed Antenna with and without AMC

The Main Antenna Model and Its Study

Figure.2.1 provides an illustration of the design model. The patch has a triangle cut in the middle and is 19mm by 9.5mm in size. It is fed by waveguide that is coplanar, and the 8.8mm microstrip line by 3mm in size. The physical measurements are 25mm by 25mm. The type is created on a FR4 substrate with a 4.4 r value. The substrate is 1.6 mm thick and has a tan of 0.02. A coplanar waveguide feed necessitates that the ground be situated next to the antenna components. The feed to ground spacing (Sfg) is 0.4 mm.

Antennas are designed using coplanar waveguide feed. The wave port's length and height are used to design the antenna's port of wave.

$$width = 2(Wf + 2 * Sfg) \quad (1)$$

$$height = 2(substrate\ thickness) \quad (2)$$

Our goal is to cover a spectrum that may be occupied from about 3GHz to 6GHz along with some x-band space. The antenna covers the triple bands of 3.4GHz-5.86GHz, 10.28GHz-11.86GHz, and 13.69GHz-14.28GHz and resonates at 4.6/11/13.9GHz.

TABLE 2.1. Dimensions (in mm)

R	Lc	Wc	Luc	Wuc	La	R1	Wgg	Wp1	Wp2	Sp
4.5	**10**	**10**	**4.5**	**4.5**	**25**	**4**	**4**	**10**	**15**	**25**
Wp3	**Lg**	**Lg1**	**Lg2**	**Lg3**	**Lp4**	**Wf**	**G**	**S**	**Ls**	**Ws**
19	**8**	**8.8**	**10.8**	**13.3**	**5**	**3**	**1**	**13.3**	**50**	**50**

The table 4.1 shows the dimensions (in mm) of AMC cell unit parameters.

2. Result and Discussion

Return Loss

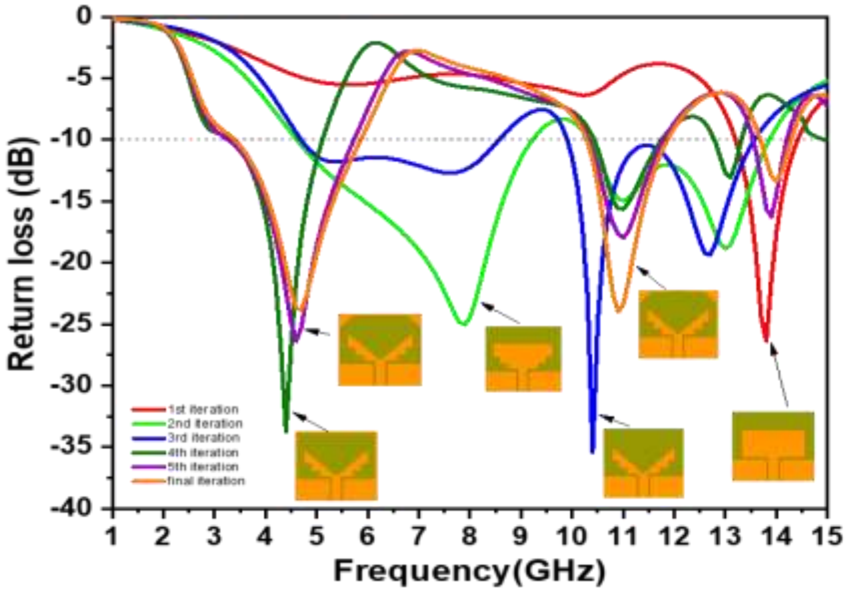

Figure 3.1 Return loss results for iterations of antenna

The finalized model operates in three bands, the first of which is the first operational band. while the other two are raised as a result of ground coupling and feed. Various unit cell and antenna dimensions are varied for the parametric analysis; the following modifications are represented graphically. Figure 3.1 depicts the various evolution stages of the proposed antenna. There are six stages, and in each stage, the inductance capacitance values are changed with respect to the antenna dimensions and structure. So the antenna is capable of resonating and different resonating frequencies in each stage of the evolution In the first iteration, the proposed antenna is resonating at dual-band. The resonating frequency is 4.25 and 14.32 GHz. then by including the steeped meandering, the antenna shift is frequency to a higher operating range along with improved bandwidth. Then the V-shaped in the patch made the antenna to resonate at three operating ranges. 3.4 GHz – 5.86 GHz, 10.28 GHz – 11.86 GHz, and 13.69 GHz – 14.28 GHz

Peak Gain

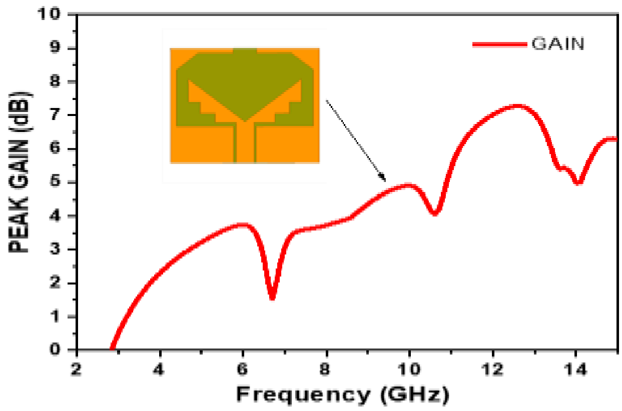

Figure 3.2 the antenna's gain without AMC

based on figure 3.2 The bands covered because of this antenna model's triple band operation are 3.4 GHz – 5.86 GHz, 10.28 GHz – 11.86 GHz, and 13.69 GHz – 14.28 GHz. The antenna's gain is positive from 2.8 GHz to 15 GHz.

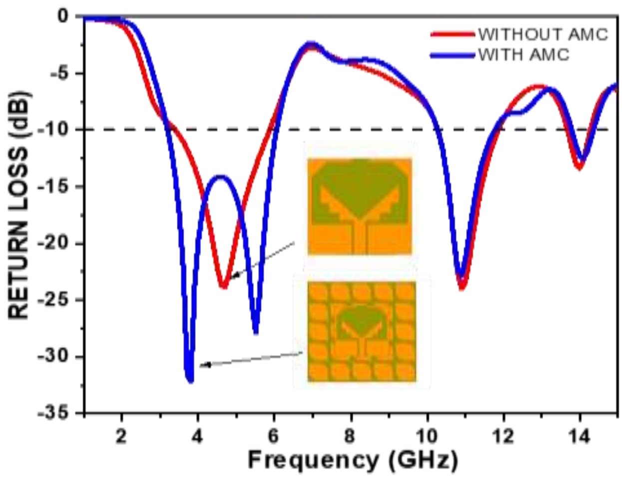

Figure 3.3 Comparison for with and without AMC.

Figure 3.3 compares the return loss for systems with and without an artificial magnetic conductor (AMC). The blue line denotes systems with AMC, while the red line denotes systems without AMC. The antenna with AMC has a dual resonance at the lower band due to the additional resonance available. The additional resonance is because of the AMC, which is available at the back of the antenna, which induces additional inductance and capacitance component.

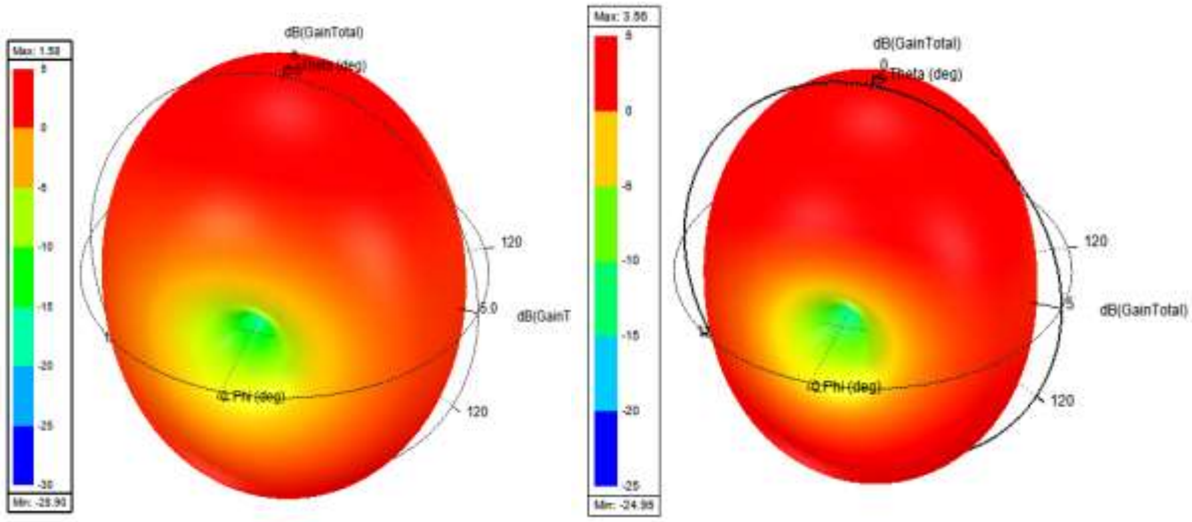

Figure 3. 4 Gain of antenna at 3.5GHz and 5.5GHz without

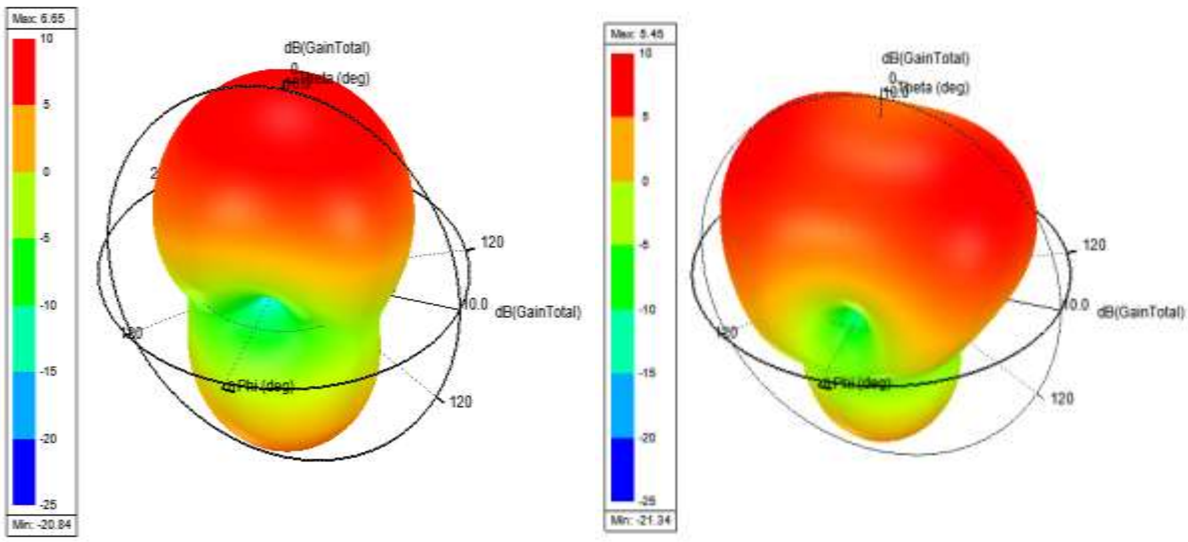

Figure 3.5 Antenna gain with AMC at 3.5GHz and 5.5GHz

For both plotted frequencies, gain increased, according to Figures 3.4 and 3.5, and when looking at the gain plot, primary lobe is growing while the lobe in the back is shrinking. So, the AMC's placement has resulted in a smaller back lobe.

3. Conclusion

A CPW antenna that draws inspiration from metamaterials is created to work in three bands with circular polarisation. 4 GHz – 5.86 GHz, 10.28 GHz – 11.86 GHz, and 13.69 GHz – 14.28 GHz The prototyped antenna's measurement tests and simulated performance agree very well. The gain of the antenna is above 2dBi in all the operating bands. The proposed antenna outperforms all the antennae in the literature in terms of size and its parameters.

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