Slotted Squares With Triangles Structure Integrate Over RMPA For Enrichment Of Variant Parameters

Krishna kant Digharra, Sandeep Agarawal

***Abstract*—In this paper Rectangular Microstrip Patch Antenna with "Slotted squares with triangles" shaped metamaterial cover is designed and replicate at a height of 3.2mm from the ground plane.The antenna along with the proposed metamaterial cover is designed to resonate at 1.9 GHz frequency . But the proposed metamaterial structure cover significantly reduces the return loss and increases the bandwidth, and directivity of the antenna in comparison to rectangular microstrip patch antenna alone. The proposed antenna is suitable for application of WLAN requiring 32.3 MHz bandwidth space and reduced return loss, of about -39.24dB . Hence there is increase in directivity of the metamaterial about 7.023Db . The purpose of this work is to design a compact and efficient antenna with simultaneous negative permittivity and permeability or the so-called Left Handed Metamaterial. Nicolson-Ross-Weir approach has been used for verifying the double-negative properties of the proposed metamaterial**

***Keywords*—Rectangular Microstrip Patch Antenna (RMPA),Double Negative Left-Handed Metamaterial, Return loss (LH-MTM Slotted squares with triangles.**

I. INTRODUCTION

The Microstrip Patch antenna are an intensify antenna based on their applications, like low assembly weight, inexpensive and cost, and easy to integrate with accompanying electronics. and operating at high frequency range.History of LHM was started from Veselago [1] when he made a theoretical assumption of this artificial material that revaluate negative permittivity and negative permeability. Smith made the first exemplar structures of LHM [2]. The Metamaterial, are left-handed metamaterial (LHM) where the permeability and permittivity are simultaneously negative.With these properties, the LHM will be mainly used to focus on the radiation of an antenna. LHM certainly deserves more than an increased gain in the microstrip technology, decrease patch antenna size, adjusts the bandwidth and also find its application in filtering the unwanted signals. Computer Simulation Technology (CST-MWS) Software has been used for all the simulation. patch antennas have several advantages compared to convention Microwave antennas, and therefore many applications cover the broad frequency range from 100MHz to 100GHz. Some of the principal advantages of micro strip patch antennas compared to conventional microwave antennas are light weight, thin profile configurations, robust nature, low fabrication cost, dual-frequency and dual-polarization antennas can be easily made and can be easily integrated with microwave integrated circuits

II. DESIGNING METHOD AND SIMULATED RESULTS

The microstrip patch antenna (Rectangular) parameters will be calculated by these formulas

Desired Parametric Analysis

Calculation Of Width(W)

$$W = \frac{1}{2f_r\sqrt{\mu_0\varepsilon_0}}\sqrt{\frac{2}{\varepsilon_r+1}} = \frac{C}{2f_r}\sqrt{\frac{2}{\varepsilon_r+1}} \quad (1)$$

Where,
c = free space velocity of light
ε_r = Dielectric constant of substrate

The effective dielectric constant of the Microstrip antenna to account for fringing field.

Effective dielectric constant is calculated from**:**

$$\varepsilon_{eff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left(\frac{1}{\sqrt{1+\frac{12h}{w}}}\right) \quad (2)$$

The actual length of the Patch (L)

$$L = L_{eff} - 2\Delta L \quad (3)$$

where

$$Leff = \frac{C}{2f_r\sqrt{\varepsilon_{eff}}} \quad (4)$$

Calculation of Length Extension

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$$\frac{\Delta L}{h} = 0.412 \frac{(\varepsilon_{eff} + 0.3)\left(\frac{w}{h} + 0.264\right)}{(\varepsilon_{eff} - 0.258)\left(\frac{w}{h} + 0.8\right)} \quad (5)$$

The Essential parameters of the design are shown in table 1.

PARAMETER	DIMENSIONS	UNIT
Dielectric Constant	4.3	-
Loss Tangent	0.02	-
Thickness	1.6	mm
Operating Frequency	1.9	GHz
Length	35.44	mm
Width	45.64	mm
Cut Width	5	mm
Cut Depth	10	mm
Path Length	32.82	mm
Width Of Feed	3	mm

Table 1: Rectangular Micro strip Patch Antenna Specifications.

III. DESIGN AND ANALAYSIS OF MICRO STRIP PATCH ANTENNA

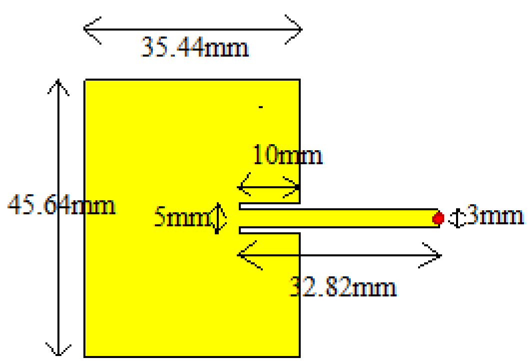

Figure 1: Rectangular microstrip patch antenna at 1.9 GHz (all dimensions in mm). (Source: Ms paint)

Designed RMPA is simulated in CST-MWS software [5] in Transient Mode at the operating frequency, the simulated results are shown in figure 2 and figure 3 below

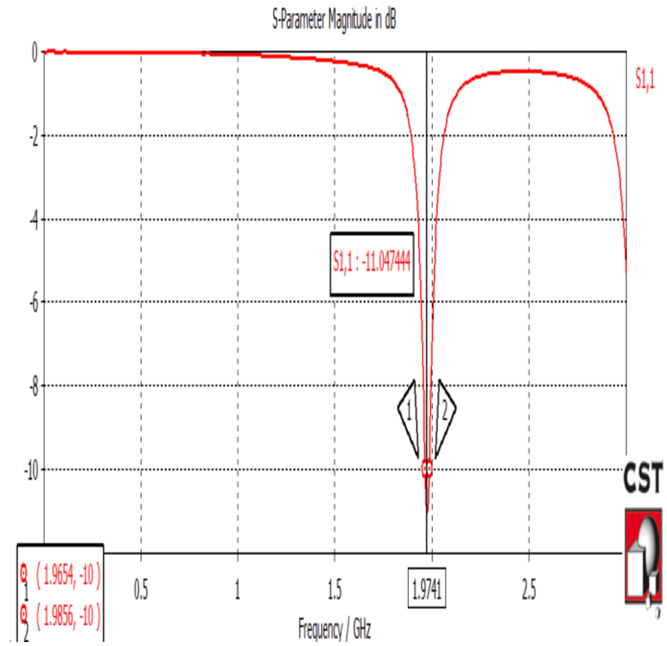

Figure 2: Simulated Result of Rectangular microstrip Patch antenna showing Return Loss of -11.04 dB. (Source: CST)

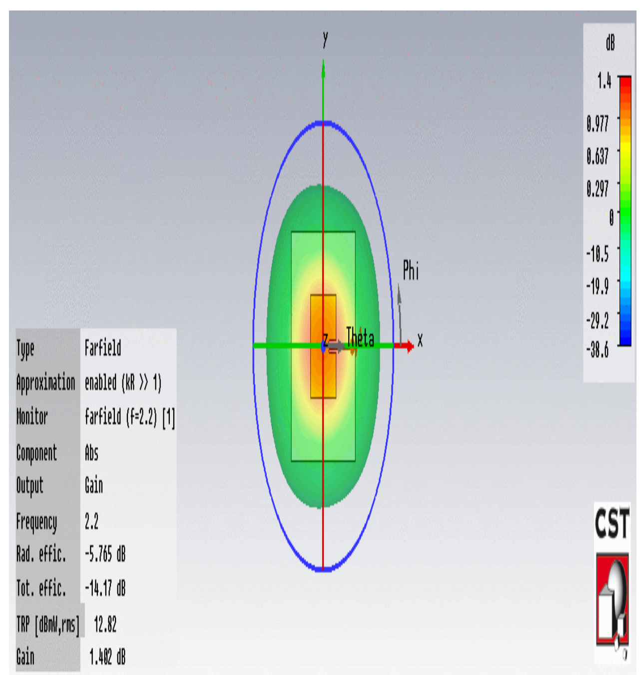

Figure 3: Radiation Pattern of Rectangular microstrip patch antenna showing gain of 1.402dBi (Source: CST)

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IV. DESIGNING AND SIMULATION OF "SLOTTED SQUARES WITH TRIANGLES" DOUBLE NEGATIVE META MATERIAL STRUCTURE

After designing & simulating the RMPA, the proposed " Slotted squares with triangles" shaped metamaterial cover is taken into analysis as shown.

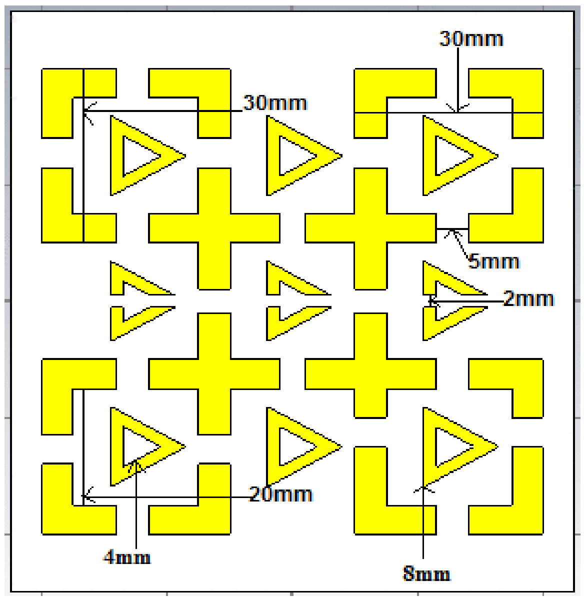

Figure 4: Dimension view of the proposed design (all dimensions in mm).

RMPA integrated with proposed metamaterial cover at a height 3.2mm from the ground plane as shown in figure 5.

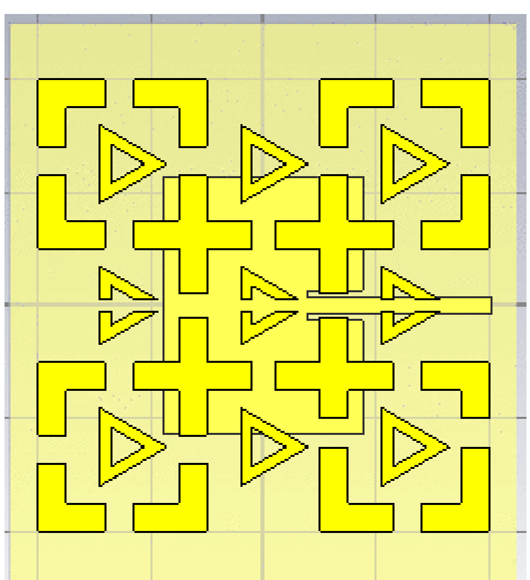

Figure 5: Rectangular microstrip patch antenna along with "Slotted squares with triangles" shaped metamaterial cover at a height of 3.2mm from the ground plane. (Source: CST)

The simulated results of the RMPA along with proposed metamaterial cover are shown in figure 6 & 7, it has been found that the potential parameters like [14][15] of the proposed antenna increases significantly in comparison to RMPA alone. The return loss of the RMPA along with proposed metamaterial cover is reduced by 39.24dB.

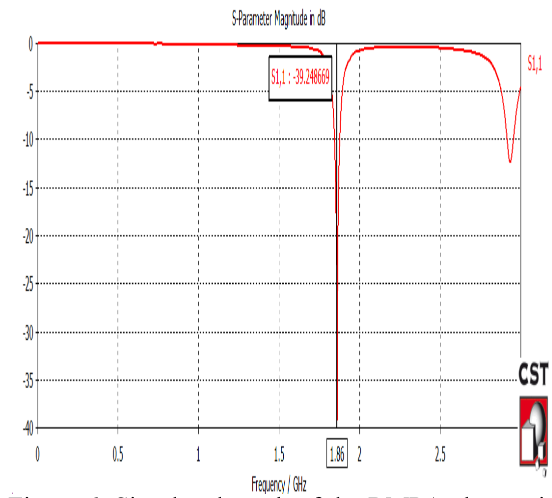

Figure 6: Simulated result of the RMPA along with proposed metamaterial cover showing Return Loss of -39.24dB. (Source: CST)

The figure 7 below shows the radiation pattern of the RMPA along with proposed metamaterial cover. It has been observed that the gain is improved by 4.364dBi in comparison with the RMPA alone

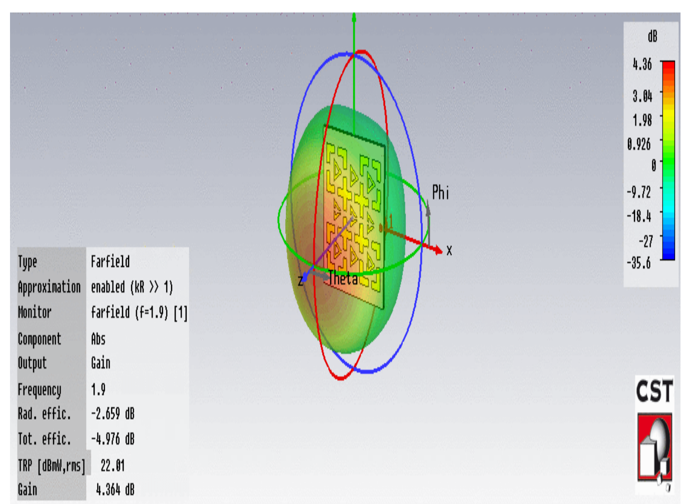

Figure 7: Radiation Pattern of the RMPA along with proposed metamaterial cover showing gain of 4.364dBi.(Source: CST)

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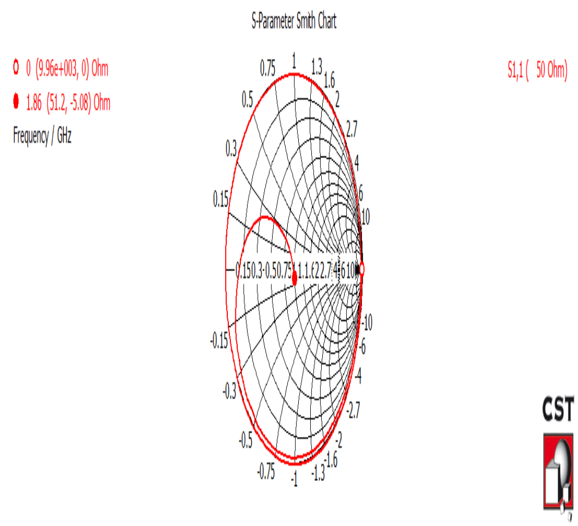

Figure 8: Smith chart of the RMPA along with proposed metamaterial cover at 1.86GHz. (Source: CST Figure 8 shows the smith chart [6][7] of the RMPA along with proposed metamaterial cover, it is clear from the figure that the impedance of the antenna is matched with the co-axial cable i.e., 50Ω

V. RESULT AND CONCLUSION

We can see that RMPA structure having certain condition can be intensify by using LH-MTM. So that its bandwidth,return loss and gain could be improve. Hence this work could be further raise by using variant patterns of metamaterial structures.

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BIOGRAPHIES

Krishna kant digharra received the B.Tech degree in Electronics and communication from S.R.I.T.S Datia Madhya Pradesh in 2012. Currently he is persuingM.Tech in communication system branch from RJIT College Gwalior, Bhopal, (M.P). His research interest includes Antenna and micro wave communication and their applications.

Mr. Sandeep Agarawal has been the Guide Teacher in the presented work

