Design Slotted Patch Antenna on Layer 1.6mm

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ABSTRACT
The purposes of this paper are to describe analytical and experimental design approaches for Rectangular Microstrip Patch Antenna for improvement of Bandwidth and Return Loss. This paper proposes a Conventional Rectangular patch antenna and Rectangular Slot as on Patch antenna. The simulation results show that an antenna with Rectangular Slot has improved bandwidth and return loss significantly by changing the frequency. Experimental results indicate that the impedance bandwidth, defined by -10dB return loss, of the proposed wide slot antenna can reach operating bandwidth of 218MHz and Return Loss -25.74dB through rectangular slotting in conventional rectangular while conventional rectangular Microstrip patch antenna bandwidth is 57MHz and Return Loss is 18.96dB.

Keywords
Bandwidth, Rectangular Microstrip patch Antenna, Return Loss.

1. INTRODUCTION
The Antenna serves to a communication system purpose that eyes and eyeglasses same to a human [1]. This is as one of the critical components in any wireless communication system. In general, the antenna behaves as a transducer between a guided wave and a free space. A microstrip patch antenna is characterized by its length, width, input impedance and gain and radiation pattern. It is consists of conducting patch on a ground plane separated by dielectric substrate. The new and vibrant field of Microstrip antennas was initially driven by the quest for low cost conformal radiators to suit the miniaturization trend of the last decade of the century. The Wireless technology boom of the modern days has fuelled a new dimension to this field. The chapter serves to highlight the historical developments that have led to the progress of this young antenna technology. The characteristics of a microstrip patch antenna are discussed briefly followed by an overview of the various analysis techniques that have kept pace with the technology itself. The term Wireless stood to describe the historic Electric Wave communication mechanism demonstrated by Heinrich Rudolph Hertz in 1886. This validated the elegant Unified theory of electricity and magnetism formulated by his teacher James Clerk Maxwell in the book a treatise on Electricity and Magnetism in the year 1873. Ten years later in February 1896, Guglielmo Marconi of Bologna, Italy demonstrated the increased signaling range (1.75 miles) achieved by Hertz a wave by using an elevated aerial and earth connection [1], initiating a commercial enterprise for wireless telegraphy. Drawing inspiration from the experiments of the great Indian scientist Jagadish Chandra Bose and other successors of Hertz, in 1901 Marconi performed the remarkable Transatlantic Experiment, transmitting the letter S (three dots in Morse code), over a distance of 700 nautical miles, thus constituting an epoch in scientific history [2]. The wavelength used to be around 600 meters. Later in December 1924, Appleton and Barnett conducted a large scale experiment proving the existence of an ionosphere that reflects short waves. This achievement coupled with the availability of Vacuum tubes for commercial applications initiated an era of radio broadcasting. The Karl Jansky's serendipitous discovery of extraterrestrial radio waves in 1932 opened a new window to the universe and he is regarded as the father of radio astronomy. A century has passed since then and mankind has, at this point of time, embraced a Wireless technology to stay wire free yet connected to everyone and everything. Over these years the connecting link between the Transmitter and Receiver and the outer world, underwent transformations from the simple wire and loop geometries employed by Hertz and his followers to the more recent ceramic chip configurations. They have evolved from simple aerials to the more complicated Smart Antennas.

The rapid development of microstrip patch antenna technology began in the late 1970s, by the early 1980s basis microstrip antenna elements and arrays were fairly well established in terms of design and designers were turning their attentions to improving antenna performance feature like as Bandwidth, Return Loss [3]. The microstrip patch antenna is present day antenna designers choice low dielectric constant substrate are generally preferred for maximum radiation. The conducting patch can take any shape but rectangular is the lengthiest of the antenna is nearly half wavelength in the dielectric; it is a very critical parameter which governs the resonant frequency of then antenna. In 1984 they arrived at the idea of combining these two geometries using a slot a microstrip feed line to a resonator. The width w of the microstrip patch antenna controls the input impedance; larger widths also can increase the Bandwidth. A narrow Bandwidth is the major disadvantage of microstrip patch antenna in practical application. For present day wireless communication system the required operating Bandwidths for antennas are about 7.6% for a GSM (890-960MHz), 9.5% of a digital Communication System (DCS 1710-1880MHz), 7.5% of Personal Communication System (1850-1990) and 12.2% for a universal mobile telecommunication system (UMTS 1920-2170MHz).

2. DESIGN OF RECTANGULAR MICROSTRIP PATCH ANTENNA
The configuration of proposed antenna is shown in figure 1. The proposed wide slot has a dimension of L is 35.35mm & W is 45.63mm and is printed on a substrate of thickness h 1.6mm and relative permittivity =4.4. The printed wide slot is etched on ground substrate. The wide slot is fed by a 50-microstrip line. The basic rectangular slot microstrip-line-fed printed wide-slot antenna design-1 is shown in Figure 1. For exciting the operating frequency at around 2 GHz, the dimension of the square slot can be roughly determined by Where c is the speed of light in the air, is the effective relative permittivity and L is the length of the square slot. And Other Antenna Design Parameter is shown in The Figure 3. Figure 2, & 4 The Simulation Results of Return Loss Of The Simple Rectangular Microstrip Patch Antenna Fed By Microstrip Line, Slotted Rectangular Shaped on patch from the ground plane to height 1.6mm. This paper presents the effect of the

slots on patch shifted resonant frequency, impedance bandwidth, Return Loss.

3. RECTANGULAR PATCH ANTENNA FED BY MICROSTRIP AT HEIGHT OF 1.6 MM FROM GROUND PLANE

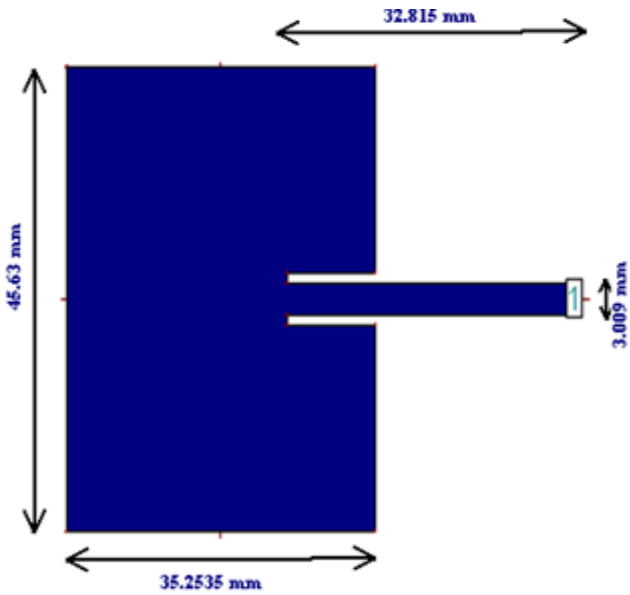

Figure 1: Rectangular Microstrip Patch Antenna

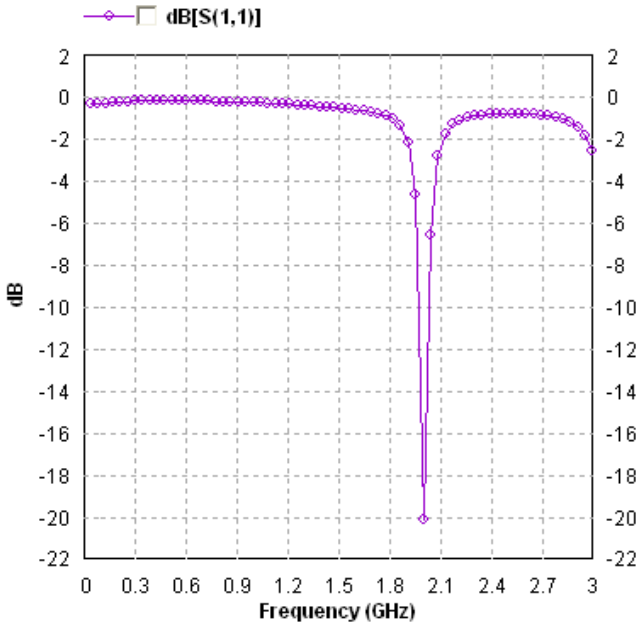

Figure 2: Simulation Results of Return Loss of Rectangular Microstrip Patch Antenna

Slot on Rectangular Patch

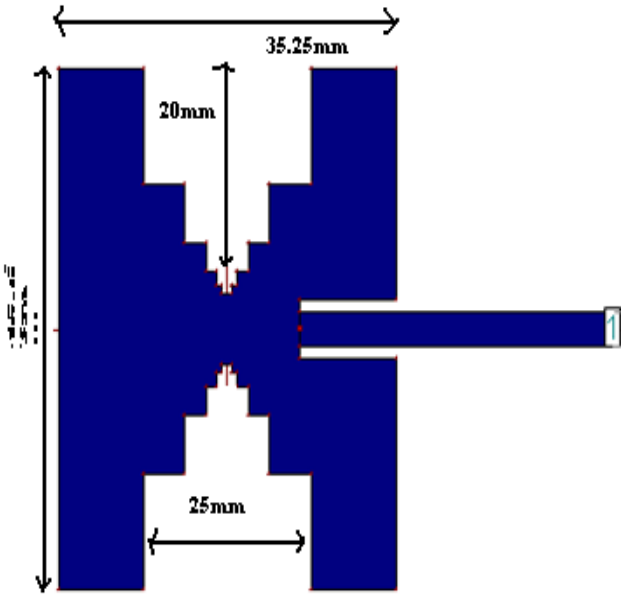

Figure 3: Slot on patch

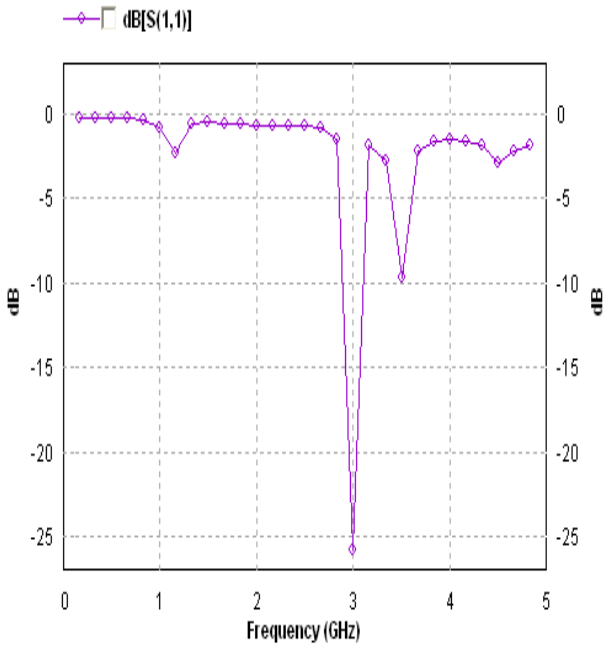

Figure 4: Simulation Results of Return Loss

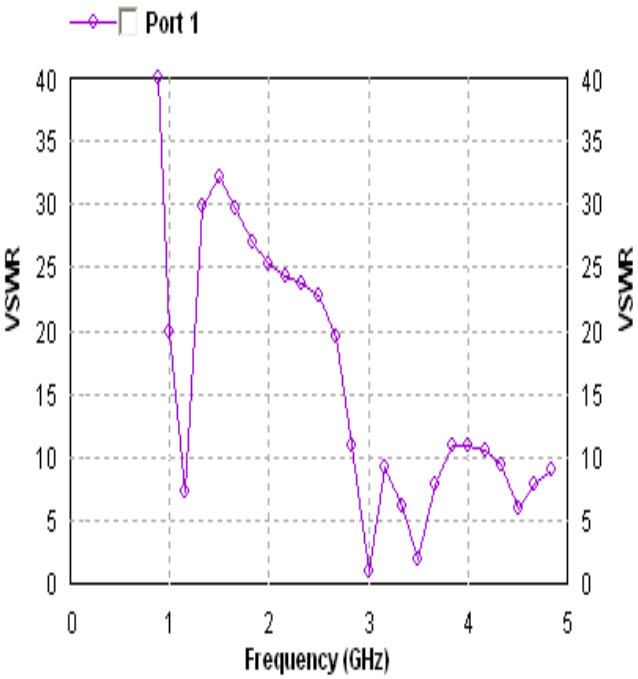

Figure 5: Simulation Results of VSWR

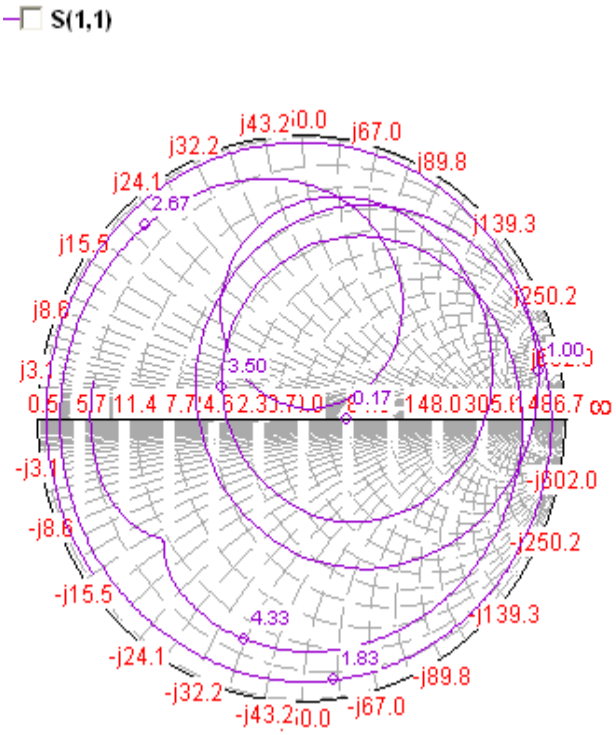

Figure 6: Simulation Results of Smith Chart

4. METHODOLOGY

The heart of a microstrip patch antenna is the upper conductor. The patch of finite dimensions [2]. The patch can be considered to be an open-ended transmission line of length and width. The amplitude of surface currents becomes significant when the signal frequency is close to resonance by taking only the fundamental mode into account. The resonant frequency can be calculated by

$$f_o = \frac{c}{2(L + 2\Delta L)\sqrt{\varepsilon_{reff}}}$$

Where ΔL is the equivalent length extension that accounts for the fringing fields at the two open ends and ε_{reff} is the effective relative permittivity. A microstrip structure is not homogeneous because the electromagnetic field extends over the two media air and dielectric. Therefore wave propagation cannot be TEM. Since wave in two media travels with different velocities and the boundary conditions force nonzero transverse electric or magnetic components.

The inhomogeneous microstrip line is replaced by an equivalent homogeneous line. The conductor retains the same geometry but is surrounded by a homogeneous dielectric of effective permittivity ε_{reff} whose value is determined by evaluating the capacitance of the fringing. The effective dielectric constant of the Microstrip antenna to account for fringing field.

Effective dielectric constant is calculated from:

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

Width of metallic patch (W)

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

Where,

c = free space velocity of light

ε_r = Dielectric constant of substrate

Length of metallic patch (L)

L = Leff - 2ΔL

Where

$$\text{Leff} = \frac{C}{2f_r\sqrt{\varepsilon_{eff}}}$$

Calculation of Length Extension

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

Calculation of VSWR

VSWR=S=

$$\frac{1 + |\Gamma|}{1 - |\Gamma|}$$

Where Γ = Reflection Coefficient

Calculation of Return Loss

When an electromagnetic wave travels down a transmission line and encounters a mismatched load or a discontinuity in the line, part of the incident power is reflected back down the line. The return loss is defined as

Return Loss=$20\log|\Gamma|$.

5. RESULT AND DISCUSSIONS

The design of RMPA for 3GHz has been done. First of all necessary parameters are calculated by the formula for giving frequencies and after that by using IE3D Software the simulation is done with the calculated parameters. Using iterative method on the value of cut width and cut depth, the Return Loss is maximum -18.96dB Simulated Results. And Bandwidth Improvement is 0.218GHz, and return loss is 25.74dB. Bandwidth 3.10973GHz-2.89167GHz =218MHz At 3GHz ant Return loss is at 3GHz =-25.74dB, No. of step 31 and frequency range is 0 to 5GHz VSWR= 1.10

6. CONCLUSION

In this work it is found that the insertions of Slotted in Rectangular Shape at a height of 1.6mm from the ground Plane, Rectangular Microstrip Patch Antenna ultimately enhance Bandwidth significantly. This had also been proven that the focusing effect of Slots really reduces Return Loss as well as improve Gain and Directivity of such types of Antenna.

Rectangular Microstrip Patch Antenna can provide printed radiating structure, which are electrically thin, lightweight and low cost, is a relatively not too old.

7. REFERENCES

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