A Review on Reconfigurable Rectangular Edge Fed Microstrip Patch Antenna for Mobile Application

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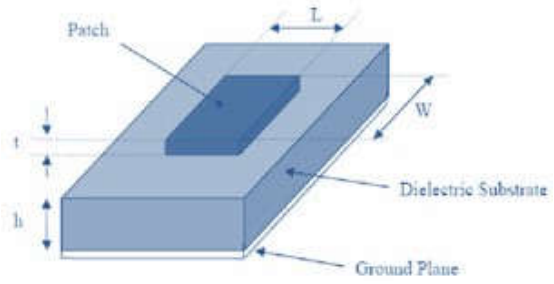
I.INTRODUCTION

An antenna is an electrical conductor or a system of conductors which is "that part of a transmitting or receiving system that is designed to radiate or receive electromagnetic waves"[1]. A Microstrip antenna consists of a thin metallic conductor which is bonded to thin grounded dielectric substrates. The size miniaturization of Microstrip patch antenna is crucial in many of the modern day practical applications, like that of Wireless local area networks(WLAN's), mobile cellular handsets, global position satellites (GPS) and other upcoming wireless terminals. Patch antennas play a very significant role in today's world of wireless communication systems. A Micro strip patch antenna (Fig 1) [3] is relatively simple in construction and makes use of a conventional Micro strip fabrication technique which comprises of the etching of the antenna element pattern in a metal trace which is bonded to an insulatingdielectricsubstrate, such as aprinted circuit board(PCB), with a continuous metal layer bonded to the opposite side of the substrate which acts as the ground plane. The most commonly used Micro strip patch antennas are rectangular patch antennas, and even circular patch antennas are widely used.

II.MICROSTRIP PATCH ANTENNA

Microstrip patch antennas possess a very high antenna quality factor (Q) which represents the losses associated with the antenna where a large Q would lead to a narrow bandwidth and low efficiency. The factor Q can be reduced by increasing the thickness of the dielectric substrate but as the thickness will increase there will be a simultaneous increase in the fraction of the total power delivered by the source into a surface wave which can be effectively considered as an unwanted power loss since it is ultimately scattered at the dielectric bends and causes degradation of the antenna characteristics. Other problems such as lower gain and lower power handling capacity can be overcome by using an array configuration for the elements which is a collection of homogeneous antennas oriented similarly to get greater directivity and gain in a desired direction. The inset-fed microstrip antenna provides impedance control with a planar feed configuration.



The structure of the Micro strip patch antenna consists of a thin square patch on one side of a dielectric substrate and the other side having a plane to the ground. In its most fundamental form, a Micro strip antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on other side as shown in the figure below. The patch is generally made of conducting material such as copper or gold. The basic antenna element is a strip conductor of length L and width W, on a dielectric substrate. The thickness of the patch being *h* with a height and thickness *t* is supported by a ground plane. The rectangular patch antenna is designed so that it can operate at the resonance frequency. The length of the patch for a rectangular patch antenna normally would be

$0.333\lambda < L < 0.5\ \lambda$,

Where, λ being the free space wavelength. The thickness of the patch is selected to be in such a way that is $t<<\lambda$. The length of the patch can be calculated by the simple calculation from

$L \approx 0.49\ \lambda d = r\varepsilon\lambda 49.0$ ---------- Eq. (1.1)

The height *h* of the dielectric substrate is usually

$0.003\lambda o \leq h \leq 0.05\lambda o$.
The dielectric constant of the substrate (εr) is typically in the range $2.2 \leq \varepsilon r \leq 12$.

WORKING: The patch of the antenna is being excited by feed which is done by edge feed , a probe feed or coaxial feed or an aperture feed. When the patch is excited by feed a charge distribution is being established between the ground plane and the underneath of the patch. The underneath of the patch is charged to positive and the ground plane is charged to negative after the excitation by feed. The attractive forces are being setup between the planes i.e., patch underneath and the ground plane. The patch antennas radiate in the first case due to the fringing fields between the underneath of the patch and the ground plane. For good antenna performance, a thick dielectric substrate having a low dielectric constant is desirable since this provides better efficiency, larger bandwidth and better radiation. However, such a configuration leads to a larger antenna size. In order to design a compact Micro strip patch antenna, substrates with higher dielectric constants must be used which are less efficient and result in narrower bandwidth.

III. Literature Review

[1]Mohamed Nasrun OSMAN, Mohamad Kamal A. RAHIM, Peter GARDNER, suggests that an electronically polarization reconfigurable circular patch antenna, with fixed resonant frequency and operating at Wireless Local Area Network (WLAN) frequency band (2.4–2.48 GHz,) is presented. The structure of the proposed design consists of a circular patch as a radiating element fed by a coaxial probe, cooperated with four equal-length slits etched on the edge along the x-axis and y-axis. A total of four switches were used and embedded across the slits at specific locations, thus controlling the length of the slits. By activating and deactivating the switches (ON and OFF) across the slits, the current on the patch is changed, thus modifying the electric field and polarization of the antenna. Consequently, the polarization excited by the proposed antenna can be switched into three types; linear polarization, left-hand circular polarization or right-hand circular polarization. They proposes a simple approach that enables switching the polarizations and excites at the same operating frequency. Simulated and measured results of the ideal case (using copper strip switches) and the real case (using PIN diode switches) are compared and presented to demonstrate the performance of the antenna.

[2] Prashant Chandra Bhardwaj, Ashok Kumar Kajla, Rahul Raj Choudhary proposed that a modified rectangular reconfigurable patch antenna with inset feed is analyzed and simulated for the Modern mobile communication Applications. The proposed antenna is simulated by applying CST Microwave Studio software and fed through strip line feeding. The overall size of the antenna is 48 mm × 38 mm × 1. 59 mm. The antenna has operated on two different resonant frequency bandwidth of 2.37 GHz and 2.45GHz for lower band of Wi-Max and Bluetooth
band respectively. The simulated gain of the antenna in the obtained frequency range is close to 2.82 dBi and 3.11 dBi for
OFF and ON respectively. Maximum radiations are directed normal to patch geometry and shape of patterns is somewhat similar to a dumble shape in the upper hemisphere. This Reconfigurable Patch antenna is specifically designed for the application of Mobile communication systems.

[3] E.Ramola, Dr.T.Pearson propose the design of a Reconfigurable Micro Strip Patch Antenna Using MEMS Technology A Reconfigurable Microstrip patch antenna of operating frequency in the range of 5-8 GHz(CBand), for the application of wireless communication has been designed. The term Reconfigurability refers that it adaptively changes its characteristics. A MEMS-based switch is inserted in the patch to control its configuration. Patch antenna using switchable slots shows different resonant features with different states (ON &OFF) of the switch. When the switch is in the OFF mode, the electric currents on the patch have to flow around the slot, resulting in a relatively long length of the current path. Therefore, the antenna resonates at a low frequency. In contrast, when the switch is in the ON mode, some of the electric currents can go directly through the switch. In this case, the average length of the current path is shorter, so that the antenna has a higher resonant frequency. The antenna was designed and analyzed using ANSOFT HFSS.

[4] Haydar M. Al-Tamimi, Salah Mahdi studied on introduction to the reconfigurable antenna technology is presented. After that a discussion about the main advantages and disadvantages of the reconfigurable antenna in addition to the most important applications that can be used with the reconfiguring techniques, studyingthe history of this technology with a brief literature survey is explained. A detailed description for this technique with examples and background information are specified, reviewing the different reconfigurable antenna components, which can be used in an antenna to adjust its construction and

functionality. These reconfigurable antenna techniques are grouped with a different classification methods to explain whichever established on the physical modification of the reconfigurable antenna radiating component, or on the integration of micro-electro-mechanical structures (RF-MEMS), varactors, PIN diodes, photoconductive components, or on the function of smart materials like ferrites and liquid crystals, etc.

[5] Ibrahim Tekin, Michael Knox studied on A reconfigurable microstrip patch antenna with RF pin diode switches is implemented for dual band of 2.4 GHz and 5.6 GHz WLAN Software Defined Radio (SDR) applications. For the dual band SDR system, the use of a single antenna with a wide bandwidth to cover both of the bands can be limiting for low power level signal applications due to wideband noise as well as changing radiation pattern at different frequencies. A reconfigurable nested microstrip patch antenna is designed on a Rogers 5880 RT/DUROID substrate which is fed by a coaxial probe from the back side of the grounded substrate. RF switching circuitry involves four RF pin diodes at each side of the inner patch. The dual bands of 2.4 GHz and 5.6 GHz frequency operation can be simply obtained by switching the PIN diodes on and off. The antenna is well matched and achieves approximately 7 dBi gain at both frequency bands. Simulation and measurement results show that the nested patch antenna is suitable for dual band WLAN SDR applications

IV. Conlusion

Reconfigurable Rectangular Edge Fed Microstrip Patch Antenna for Mobile Application at 5 G Hz frequency.

References:

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