Design and Analysis of Frequency Reconfigurable U-Slot Microstrip Patch Antenna Based on Varactor Diode

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***Abstract*—We present a frequency-reconfigurable microstrip patch antenna. It has been discovered that adding a U-slot to a patch antenna can give it a flat input resistance and linear input reactance over a larger bandwidth than a traditional patch antenna. The antenna's impedance matching frequency can be adjusted by attaching a variable capacitor and an inductor to the antenna input be diverse. The manufactured prototype antenna achieves a frequency range that is tunable between 2.6 and 3.35 GHz. The proposed antenna has a straightforward design, with the control circuitry tucked beneath the ground plane. It is suitable for use in multichannel systems to reduce crosstalk from adjacent channels. Frequency tunable, microstrip patch, and reconfigurable antennaare the index terms**

I. INTRODUCTION

The use of MICROSTRIP patch antennas in wireless communication systems is common. Traditional microstrip patch antennas, however, have the drawback of having a limited bandwidth, making them unsuitable for current systems for mobile communication. One of the methods suggested to expand the impedance matching bandwidth of probe feed microstrip patch antenna with thick substrate is the inclusion of a U-shaped slot on a microstrip patch. Accordingly, if a thick substrate is utilized, the U-slot could add a capacitive component to balance off the high input inductance.one of the methods suggested to alter a microstrip antenna's resonance frequency is presented. The ground plane and substrate are separated by an air gap, which could reduce the ground plane and substrate are separated by an air gap, which could reduce the cavity's effective permittivity. As a result, the antenna's resonant frequency may be modified by varying the air gap's thickness. However, in practice, this method calls for mechanically altering the air gap width, which is a difficult process. In recent years, interest in reconfigurable antennas has grown. Typically, switches, variable capacitors, varactor diodes, or MEMS switches are incorporated into the antenna design to enable performance reconfiguration. These make it possible to modify the frequency response, radiation patterns, gain, or a combination of several antenna properties. It presents a dual-band slot antenna. altering the bias that is applied across a varactor diode, The matching frequency could change as a result of, which creates a variance in capacitance. Although these publications included the components on the radiating element, which may cause issues with the production of antennas. This letter introduces a frequency-tunable U-slot microstrip patch antenna. The frequency of the antenna is managed by a variable chip capacitor (trimmer). In the sections that follow, the geometry and outcomes of the suggested antenna will each be provided separately, along with a brief explanation of the U-slot's purpose. Finally, a final observation will be made. The` design of a dual-band antenna in involves placing a chip capacitor across the slots, and the impedance matching frequency may change depending on the value of the capacitor.

II. OBJECTIVE

1. To design frequency reconfigurable patch antenna without varactor diode.
2. To maximize the antenna performance.
3. It will operate at different band of frequencies.
4. High bit data transmission can be achieved.
5. To design frequency reconfigurable patch antenna using varactor diode.

III. LITERATURE SURVEY

A. *Frequency Reconfigurable U-slot Microstrip patch Antenna.*

In this paper We have taken the design part for Designing of a u-slot microstrip patch antenna. We have taken U- slot only because a U-slot to a patch antenna can give it a flat input resistance and linear input reactance over a larger bandwidth than a traditional patch antenna. The proposed antenna has a straightforward design, with the control circuitry tucked beneath the ground plane. It is suitable for use in multichannel systems to reduce crosstalk from adjacent channels.

B. *Frequency reconfigurable octagonal ring -shaped Quad-port dual-band antenna based on varactor diode.*

The authors have explained about a Varactor diode, where the antenna's impedance matching frequency can be adjusted by attaching a variable capacitor and an inductor to the antenna input**.**

IV.METHEDOLOGY

A. Design of an microstrip patch antenna in a HFSS software.

Here proposed U-slot frequency adjustable antenna's shape is depicted in the patch is positioned 12 mm (H) above the ground plane and has dimensions (W XL) of 77 mm 57 mm. While free space is used in the simulation, foam is employed to support the patch in the manufactured prototype. The U-slot measures 32 mm in width, 31 mm in length, 2 mm in gap width, and is 14.5 mm away from the upper border of the patch (U). The U-slot patch antenna is excited by a probe, which is placed 26 mm from the patch's lower edge (d). The ground plane measures 150 mm (W x L). Under the ground plane, a microstrip transmission line is constructed for the tuning components' fixture. The substrate is 1.524 mm thick with a dielectric constant of 2.6. On the back of the antenna, is where the tuning circuitry is housed. At the point where the feeding probe connects to the microstrip line.

B. Placing of a varactor diode at the back side of a design.

The tuning components are connected to the microstrip line. By adjusting the capacitance value of the variable chip capacitor (trimmer), the antenna's matching frequency could be adjusted. The trimmer used in this prototype is a TZW4 design from Murata Co. The capacitance range of the trimmer is 0.4 - 1.5pF.

C. Fabrication

And this step has been done to match the result of simulation with the fabrication result.

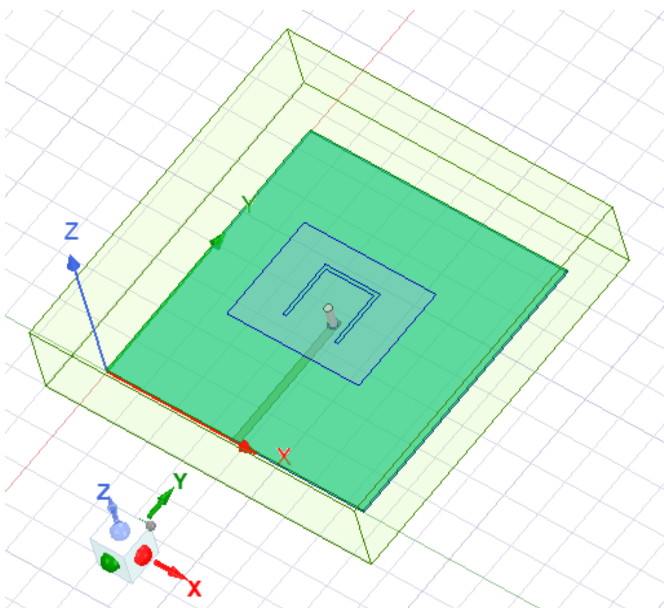

Fig.1. Geometry of a proposed antenna

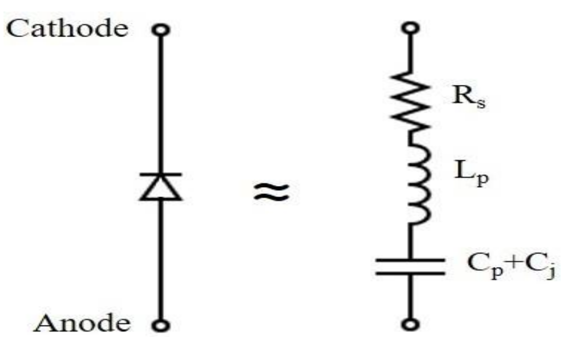

Fig.2 Equivalent circuit of the varactor diode.

V. RESULT

To show off the suggested design's capacity for frequency adjustment, an antenna prototype is constructed. In Fig. 3, the measured return loss is displayed. The frequency of the impedance matching in the, When the trimmer's capacitance is changed, the antenna can be adjusted. Since there are no markings on the trimmer, it is challenging to pinpoint the exact capacitance value of the trimmer (see Fig. 3). Nevertheless, it is noted that the antenna achieves a tuneable range from 2.6 to 3.35 GHz (return loss dB) in the trimmer's full-scale range. This translates to a frequency ratio between the upper and lower limits of roughly 1.28.

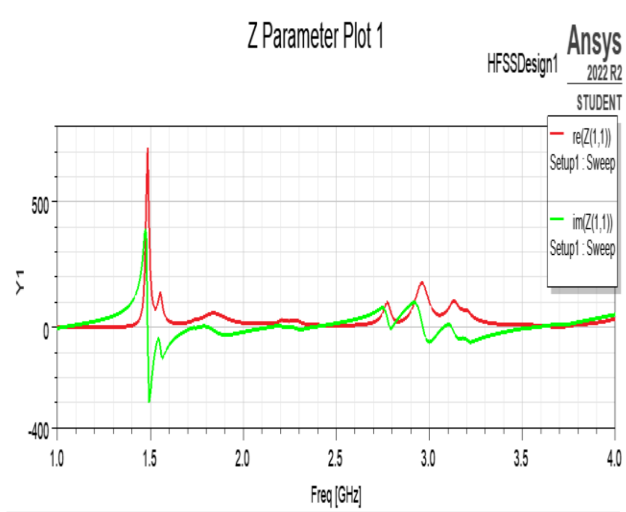

Fig. 3. U-slot microstrip patch antenna's simulated input impedance (with lump components)

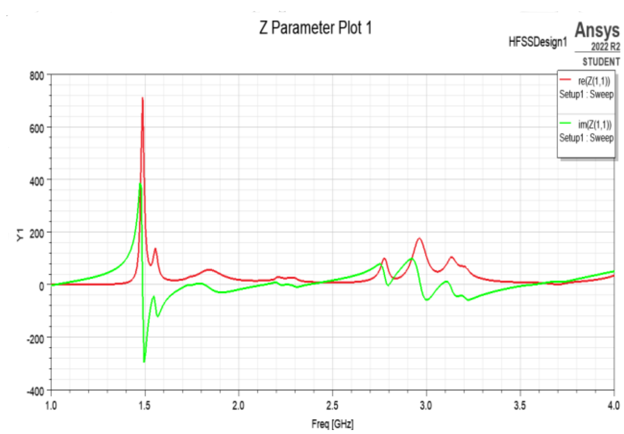

Fig. 4. U-slot microstrip patch antenna's simulated input impedance (without lump components)

A testing rig is built to measure the trimmer's real capacitance value at the working frequency. The trimmer's measured capacitance ranges from 0.37 to 1.26 pF at 3 GHz, it is discovered. This is within the allowed tolerance of 20% of the recorded value. Gaps between the trimmer and microstrip line and the effects of the soldering sites are likely to blame for the tolerance.

VI. CONCLUSION

We demonstrated a frequency-tunable microstrip antenna. A flat input resistance and a linear input reactance are produced by including a U-slot on the patch. The input reactance could be changed. Change the frequency of matches. A trimmer has been shown to be able to regulate the patch antenna's input impedance, resulting in a frequency ratio between the highest and lowest frequency of roughly 1.28.

VII. REFERENCE

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