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# Performance Analysis of Square Shaped Microstrip Patch Antenna

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**ABSTRACT**
To create a microstrip patch antenna, a metal trace is typically bonded to an insulating dielectric surface in the shape of the antenna's element pattern. This kind of antenna has a narrowband signal range and a broad beam. In order to create the ground plane on the other side, a single metal layer will be connected to the substrate. Microstrip antennas may take on many different basic forms, including square, rectangular, circular, elliptical, and annular ring. We have dissected how the length (L) of the radio wire and the overall dielectric consistent (r) of the substrate influence the transfer speed (BW) and the return misfortune (RL) of the radiation. In order to accomplish this goal, the CST platform was used. The S band is the frequency range between 2 and 4 GHz that is used by satellites, Wi-Fi, Bluetooth, cellular phones, and other devices. Both the square Microstrip patch antenna and the suggested approach have been applied to the 3.055 GHz frequency that the antennas have been adjusted to. The antenna's outcomes, both theoretical and empirical, have been shown.

***Keywords* - Band width, Radiation, Return Loss.**

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## I. INTRODUCTION

Because of their transportability, adaptability, and modest cost, microstrip recieving wires are an enticing choice. Microstrip fix recieving wires have a leading patch on a ground plane that is isolated starting from the earliest stage by a dielectric substrate. [1][2] But until the downsizing and large-scale integration of electronic circuits in the 1970s, this idea was not explored. Since then, other writers have, for a variety of setups, detailed the radiation starting from the earliest stage through a dielectric substrate. Munson's work on little strip radio wires for use as low-profile, flush-mounted recieving wires on rockets and rockets demonstrated the viability of this approach to a variety of antenna system issues. Since then, several other mathematical models of this antenna have been devised, and its potential uses have been realised in a wide range of contexts. You can gauge how significant this antenna is by looking at how many journal articles and papers have been written on it in the previous decade. As far as today's antenna designers are concerned, tiny strip antennas are the way to go

## II. Designing

The microstrip patch antennas we'll be discussing in this article come in a variety of forms, including both circular and square varieties. This means that familiarity with the relevant designing equations is essential. Variation in the antenna's width and length are used in the design calculations.

The dimensions suggested are 23 mm in length, 31 mm in width, and 0.8 mm in thickness, with the substrate being made out of FR4-epoxy and having a relative permittivity of 4.4. An exact resonance frequency of 3.055 GHz has been determined for this square patch antenna.

It additionally has the use of permittivity which has a fundamental impact in the planning of the radio wire.

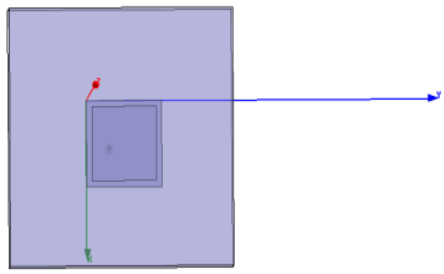

Figure 1: Microstrip patch in a square configuration.

Using the transmission line model condition, we will decide the worth of L for a microstrip fix radio wire with a square cross-segment:

$$L = \frac{c}{2fo\sqrt{\varepsilon_r}}$$

One may calculate the effective dielectric constant using the formula:

$$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{(\varepsilon_r-1)}{2}(1+12h\backslash w)^{-1/2}$$

## III. RESULT

Both theoretical and practical results have been achieved with this antenna. It has been simulated using the HFSS platform, and tested in the real world using a vector network analyzer.

### i. *Square Patch Resonance Frequency:*

The value of the reflection parameter, S11, is shown in figure 2 below. Since it is well-established that S parameters are favored in high-frequency analysis, The Z, Y, and h parameters grow intricate at high frequencies I. Since S parameters make use of the matching impedance condition at high frequencies, (ii) it is challenging to generate short and open circuit state at high frequencies, prompting their employment. S11 was measured to be -27.26507 dB at 3.55 GHz, as seen in the figure below.

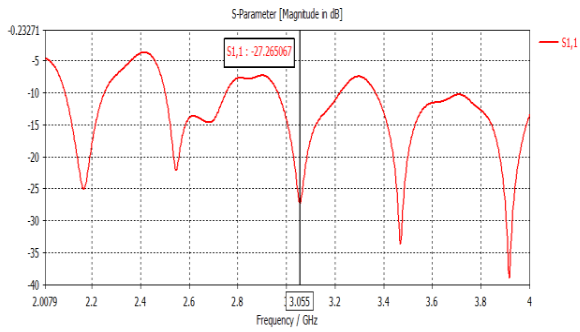


Figure 2 shows the square-molded microstrip fix radio wire's reverberation recurrence.

### ii. *Value of the S Parameter:*

A frequency sweep is shown in figure 3 below, showing how the S parameter changes. Because magnitudes below -10 dB are often preferred, it stands to reason that this is the case. Given that the greatness of the return misfortune is conversely relative to the extent of the $S_{11}$ parameter. One definition of return loss is the attenuation of a signal at a break in a transmission line or optical fibre. Also, it describes the signal after the transmission cable has been severed. The value of S11 was found to be -27.26507 dB.

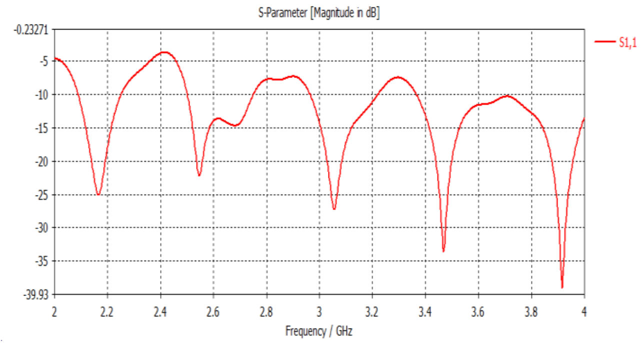


Figure 3 Square Shape Microstrip Patch Antenna S Parameter Value

### iii. *Bandwidth:*

We all know that the amount of available bandwidth is a major factor in a device's effectiveness. The antenna's bandwidth is affected by several factors, including the patch's geometry, the resounding recurrence, the dielectric steady, and the substrate's thickness. To increase bandwidth, we must also increase the antenna element's impedance bandwidth. So, in Figure 4 we see the bandwidth value around my target frequency, where the square patch antenna has been tuned to resonance. We can calculate a bandwidth of 0.25237 GHz from the graph.

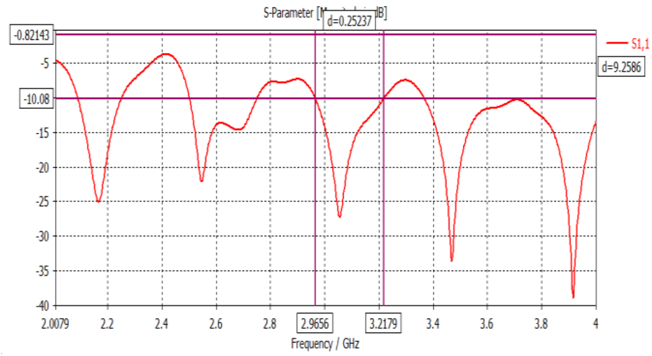


Figure 4 Square Microstrip Patch Antenna Bandwidth

## IV. EXPERIMENTAL RESULTS:

The data collected from the network analyzer is shown in figure 5. Based on these calculations, we know that the S11 parameter has a value of around -17.78325461 dB at a frequency of 3.15710696 GHz. This reaction exemplifies the fact that the outcomes acquired in practise and those achieved via simulation vary.

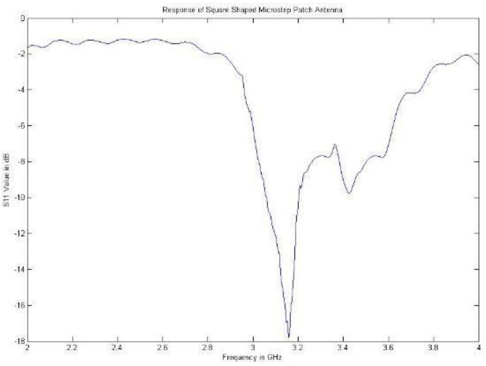


Figure 5 Square-Molded Microstrip Fix Radio wire Reaction

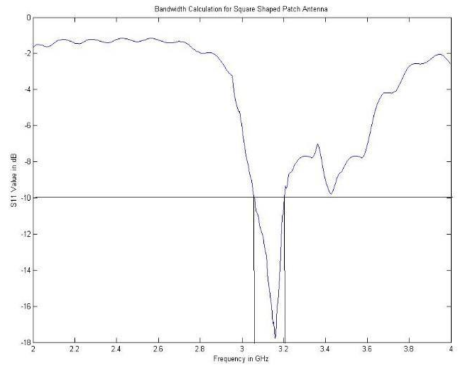


Figure 6: Square Microstrip Fix Radio wire Transfer speed

Figure 6 shows the transmission capacity of a square microstrip fix recieving wire, which is about 0.156210 GHz. Since we know that the antenna analysis would benefit from a wider bandwidth, we focus on increasing the bandwidth

Table 1
Microstrip Patch Antenna Values for a Square-Shaped Antenna

| | **Parameterr**s | **Value** |
|---|---|---|
| 1 | $S_{11}$ | -17.78325461dB |
| 2 | Bandwidt | 0.156210 GHz |
| | | |

## V. CONCLUSION

Due to resource constraints, the achieved practical result using Vector Network Analyzer has not been calibrated. The behaviour of these antennas is also shown by these findings, and we can infer from the realistically acquired data that there is some variance in both outcomes.
According on the outcome, we may draw the following conclusions:

**a. Shape's Effect on Return Loss:**
An annular ring microstrip patch antenna has a return loss of -24.27 dB, whereas a square antenna has a return loss of -27.26507 dB, making the square antenna the superior choice.

**b. Shape's Effect on Bandwidth:**
The data transfer capacity of a square microstrip fix recieving wire is higher than that of an annular ring microstrip fix radio wire. Results from training show that a square-molded radio wire has a more extensive recurrence range than an annular-ring microstrip fix radio wire.

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