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A Design Of Microstrip Square Patch Antenna For V2xcommunication

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Abstract:
Wireless technology has been adopted for use with automobiles as part of the connected car network. Particularly, V2X is a crucial piece of linked car technology.In recent years, there has been an increase in demand for antennas that are smaller and smaller due to the continually diminishing size of personal communication devices. In this paper, the size and functionality of antennas are discussed. In this study, a square micro strip patch antenna operating at 3.60 GHz for V2x communications is designed and modelled. The antenna achieves a decent gain while offering a radiation pattern that covers a large beam angle. Using the HFSS technique, the square micro strip patch antenna was evaluated.An antenna is 26 x 26 x 1.6 mm in size overall, has a relative permittivity of 4.4, and is 1.6 mm thick. It is manufactured of the inexpensive substrate FR4 glass epoxy. The recommended inset feed square patch antenna performs well in terms of antenna gain, radiation pattern, resonance frequency, return loss, and VSWR.

Keywords: *Square Micro strip antenna, Return loss, Gain, Slot*

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I.INTRODUCTION

Wireless systems are becoming more and more necessary. Low profile systems are the primary research emphasis. In order to fit inside the confines of modern communication systems, broadband antennas must be smaller and easier to design. A number of miniaturisation techniques, including using a substrate with a high dielectric constant and adding different impedance loads, should be utilised to increase an antenna's electrical length. Compact antennas with the desired resonance frequency and excellent gain efficiency can be made using the fractal approach. For a variety of applications, including Bluetooth, WLAN, Wi-Fi, WIMAX, high-speed point-to-point communication, infrared communication, satellite communication, mobile communication, GPRS, VANET, MANET, WSN, GPS, UWB, and others, top researchers have also created a number of antenna types, including the Slot, Yagi Uda, travelling wave, Microstrip Patch, and Fractal[1]. It is never simple for researchers to develop a new antenna without affecting the performance measures, even though different wireless applications link to various communications antenna types.In either instance, microstrip patch antennas and Fractal (FA) antennas can yield the best results due to their compact size, versatility in terms of operating frequencies, output of both linear and circular polarization, mechanical strength, ease of manufacture, and affordability.

Micro strip patch antennas, often known as patch antennas, are one of the most widely used types of antenna. Used in modern times, particularly in the frequently used frequency range of 1 to 6 GHz. In the 1970s, when communication systems began to expand at frequencies where this type of antenna's size and frequency range demonstrated great performance, it began to emit its first strong radiation. In comparison to parabolic reflectors and other antenna options, due to its flat profile and reduced weight, it is also preferred for use in aircraft and spacecraft. Due to similar characteristics and additional size reduction using high dielectric constant materials, more contemporary Patch antennas are frequently used in cellphones, GPS devices, and other mass-produced wireless items.

Antennas are necessary for any wireless communication system to work. Antennas come in a wide variety of styles, including wire, log periodic, travelling wave, and microstrip, aperture, and reflector kinds. The wire antenna is made up of a short dipole, a dipole, a half-wave, a wideband, a monopole, and a loop. The planar inverted-F antenna and the rectangular micro strip (patch) antenna make up the micro strip antenna. The ability to print tiny strip or patch antennas directly onto a circuit board makes them increasingly more practical. Mobile phone technology is increasingly using micro strip antennas.

Patch antennas are affordable, have a small profile, and are simple to build. Utilising printed-circuit technology, micro strip antennas are easy to install on surfaces, low profile, lightweight, and affordable to produce [2]. Better efficiency and wider bandwidth are provided by thicker substrates with lower dielectric constants, but at the expense of bigger element sizes. Lower element sizes and low coupling are produced by thin substrates with higher dielectric constants, although they are less effective and have a slightly lower bandwidth.

Micro strip patch antennas are widely used in many circularly polarised applications due to its low profile and beneficial radiation characteristics [3]. Due to the development of modern wireless systems over the past ten years, research on micro strip radiators has increased, with an emphasis on performance improvement and miniaturisations. Micro strip patch antennas are widely used in many circularly polarised applications due to its low profile and beneficial radiation characteristics. Due to the development of modern wireless systems over the past ten years, research on micro strip radiators has increased, with an emphasis on performance improvement and miniaturisations.

II.ANTENNA DESIGN AND CONFIGURATIION

V2X includes communication from vehicles to infrastructure, vehicles to vehicles, vehicles to pedestrians, and vehicles to networks. The road condition and other vehicle information are sent to the vehicle through data exchange using V2X. This knowledge will facilitate efficient traffic flow and increase pedestrian security.

Additionally, information on passing vehicles at intersections, sudden stops by unseen vehicles, and car accidents on curving roads can all be obtained using V2X communication. The information is gathered and projected vehicle risk through two parties communicating in real time while operating.

The design of a microstrip square patch antenna for operation at 3.60 GHz and 7.98 GHz is shown in Figure 1. An inset line is used in this feeding technique. The substrate is 1.6 mm thick and has a rectangular slot cut out of it. The dielectric constant, substrate thickness (ts = 1.6 mm), and resonant frequency (rf = 28.3 GHz), among other variables, are taken into consideration when building the antenna. The complete dimensions are shown in the table below. HFSS is used to excite the antenna through the lumped port. Inset type feeding is used to transmit power at the best efficiency since the antenna must be very small to match the impedance of the patch and feed line.Microstrip antenna analysis is done using a cavity and transmission line model [4]. The following equations and design process are displayed:

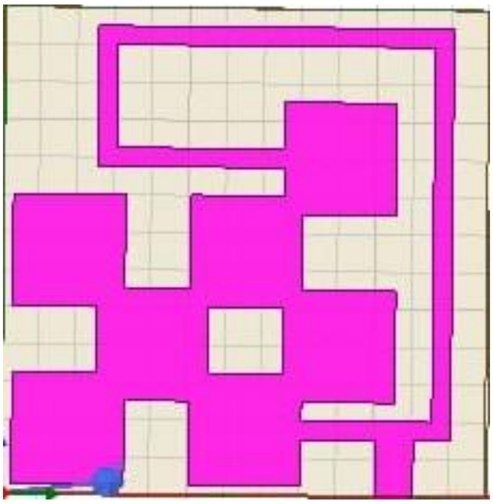


Fig-1. Designed Microstrip Patch Antenna

STEP 1: We find the calculation wavelength of microstrip square antenna

Wavelength = C×f

C-speed of light

f-frequency

STEP 2: We find the calculation, width of the antenna

$$W = \left(\frac{\lambda}{2}\right) * [\sqrt{2(\text{€}r + 1)}) \qquad \dots (1)$$

W-width of an antenna

STEP 3: We find the calculation, ground wavelength

$$(\boldsymbol{\lambda})g = \boldsymbol{\lambda}/\sqrt{}\text{€}r \qquad \dots (2)$$

STEP 4: We find the calculation, feeding length

$$Lf = (\boldsymbol{\lambda}) \qquad \dots (3)$$

The substrate is 1.6 mm thick, 26 mm by 26 mm in size, and composed of FR4 glass epoxy. Fig-1.The patch is 26 mm in width and 26 mm in length.

III. FIGURES AND TABLES

The parameters used in designing the microstrip patch antenna are shown in the table-1

Table-1. Square Patch Antenna

S.No	Parameter	Dimension(mm)
1	Length	26
2	Breadth	26
3	Width	1.6
4	Substrate	FR4 glass epoxy
5	Permittivity	4.4

Table-2. Output Parameters

Parameter	Patch Antenna
Resonant Frequency	3.60GHz
VSWR	1 dB
Gain	3.87dB

IV. SIMULATION RESULTS

Return Loss Plot:

Considered to be antenna return loss parameters are the S11 parameters. The return loss measured at 3.60 GHz is 25 dB, and the return loss acquired at 7.98 GHz is 19 dB, both using -10 dB as the base value. The plot of return loss is shown in Fig. 2.

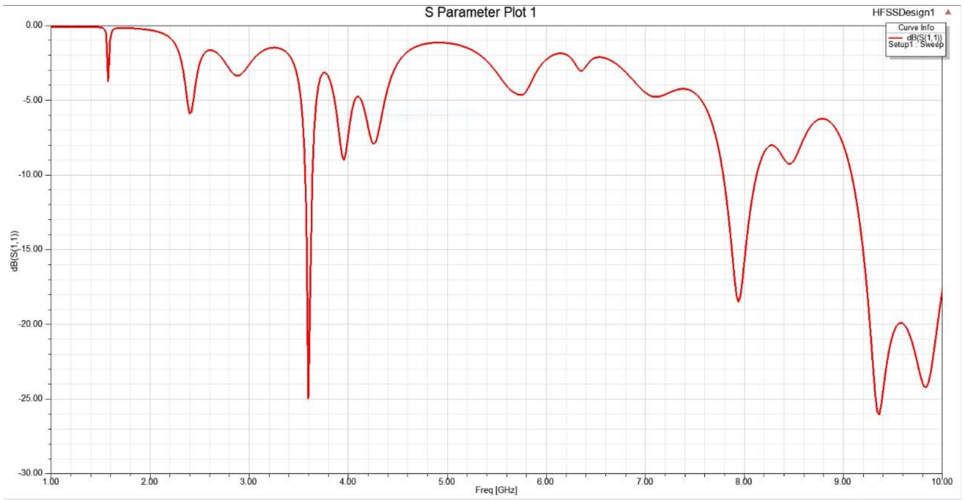


Fig-2. S-Parameters

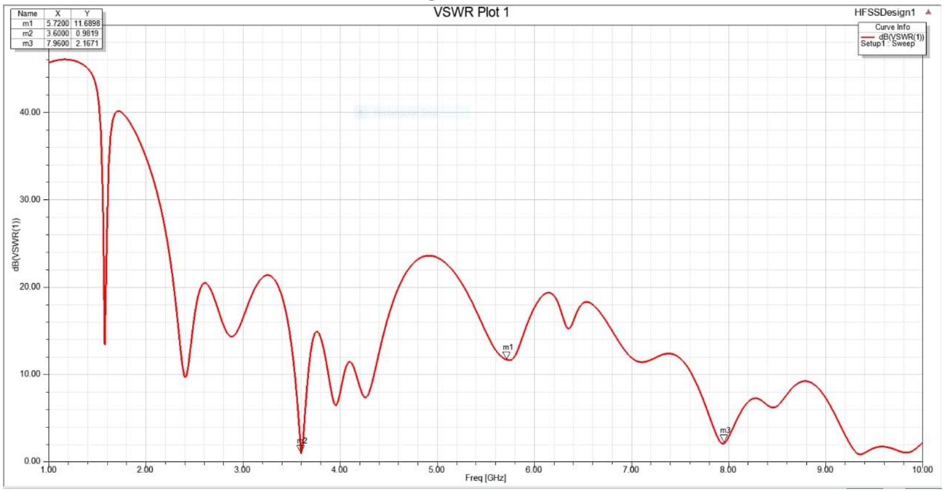
VSWR Plot:

For it to function successfully, there must be a maximum power transmission between the transmitter and the antenna. This only occurs when the transmitter and receiver's impedances are equivalent. This particular arrangement is required for an antenna to function properly. Standing waves are produced as a result of this power reflection, and they can be measured using VSWR, short for voltage standing wave ratio. The VSWR varies from 1 to 1 as the reflection coefficient changes from 0 to 1. The suggested antenna's impedance matching is good because its VSWR is 1, which is 1.

$$\text{VSWR} = VmaxVmin = 1+|\,\Gamma|\,/1-|\,\Gamma| = 1+S11/\ 1-S11$$

Fig.3 displays the voltage standing wave ratio (VSWR). The VSWR should ideally be 1 dB and, in practice, should not be more than 2.5 dB. At 3.60 GHz, this antenna has a VSWR of 1 dB.

Fig-3. VSWR



Gain Plot:

To provide a clearer image of radiation performance, gain is a phrase that describes how well an antenna operates or its capacity to concentrate energy in one direction. It is easy to assume that this refers to the direction with the maximum radiation because it is expressed in dB. The maximum gain of an antenna can be calculated as follows:

$$G\backslash\ \eta = D$$

η – The efficiency of the antenna
D – Directivity

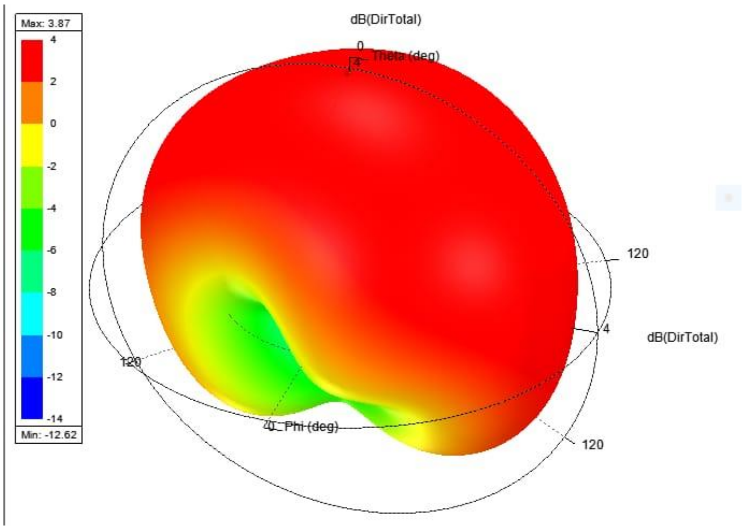


Fig-4. Gain

Radiation Pattern:
A mathematical function or a visual depiction of the far field is the definition of the radiation pattern. Antenna radiation characteristics according to the electromagnetic (EM) wave's direction of travel Fig-5.

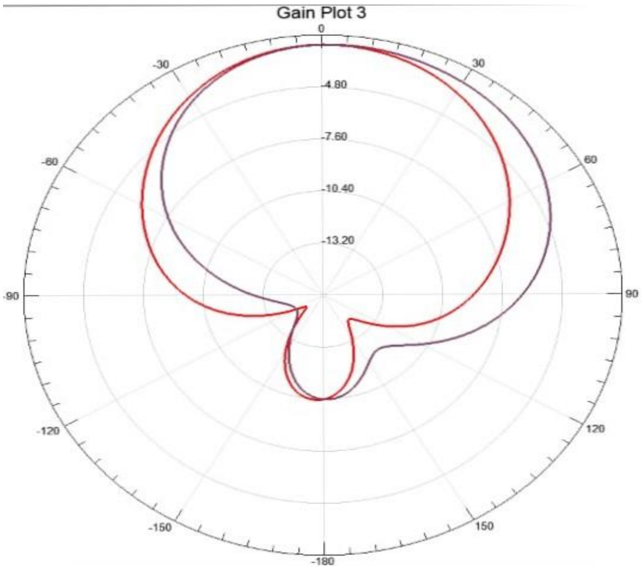


Fig-5. Radiation Pattern Smith chart

Smith Chart
Figure 6 of the Smith chart illustrates how the antenna impedance varies with frequency and provides 50 ohm impedance. The locus must be large enough to cross through the center of the smith chart in order for good matching to occur.

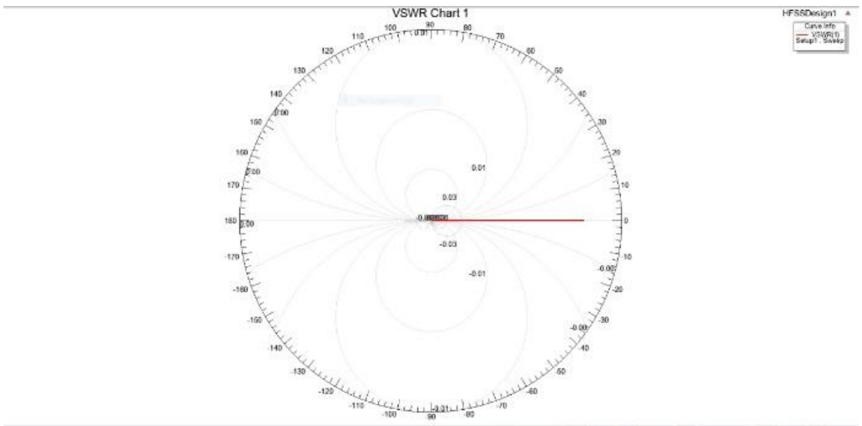


Fig-6. Smith chart

Fabricated Antenna:

Fig-7. A manufactured antenna seen from the front.

Fig-8. A manufactured antenna seen from the back.

V. CONCLUSION

Our antenna can work in several bands and has a highly distorted omnidirectional radiation pattern, making it ideal for usage in vehicles and in multipath environments. The simulation also shows how the antennas work with low power transmitters for V2X communications. With a gain of 4.5 DB, the suggested antenna radiates with a pleasing pattern. The antenna is 1.6 mm3 and 26 x 26 mm. Due to its 100 broad beam width circularly polarised response, the proposed square patch can be evaluated for various multistandard wireless systems, such as automobile applications.

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