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Microstrip Patch Antenna

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Abstract: Performance parameters like return loss, voltage standing wave ratio, gain, and radiation pattern are calculated. Design frequency is 2.4 GHz, the copper-coated substrate material is RT Duroid 5880 having dielectric constant ε=2.2 and thickness is 1.6 mm.
The feeding technique, employed in Microstrip patch Antenna is Microstrip 50 Ω feed line. employing a parametric study found that the proposed antenna design are useful for ISM band applications like Wi-Fi, Bluetooth, 2G/3G/LTE mobile communication systems.
Keywords: ANSYS HFSS, FR4 epoxy, S-boundary, Gain, Directivity

I. INTODUCTION

Microstrip Patch Antenna (MSA) is one of the most favored antenna structures because of its ease of fabrication and have many applications in wireless communication.
They are very useful nowadays because they are directly printed onto the circuit boards. In this paper, FR- 4 Epoxy material is used as a substrate. The MSA (Microstrip Patch Antenna) is widely used nowadays because of its various advantage but it also has some disadvantages but due to its various advantages, it surpasses its disadvantages.

These are some advantages of MSA: -
1) Light Weight
2) Low Profile
3) Capable of dual and triple frequency operation.

II. MICROSTRIP PATCH ANTENNA OF RECTANGULAR DESIGN

For a rectangular design equation, the configuration of the antenna of different form can be rendered Using a rectangular patch. In the beginning the rectangular antenna was created and the slots with corresponding length and width were added in order to make an antenna shape distinct. In the design of a micro strip patch antenna, the resonant frequency and dielectric media for which antenna is to be constructed should be chosen.
The antenna length and width can be determined by means of mathematical equation.

Width (W): Calculated using the following equation

$$W=Co/2fr\sqrt{(2/\varepsilon r + 1)}$$

Where, W = Width of the patch,
Co= Speed of light,
Ɛ r = dielectric substrate

The effective dielectric constant (Ɛ eff): Calculated using the following equation

$$\varepsilon reff = ((\varepsilon r + 1/2) + (\varepsilon r - 1/2)(1 + 12h/w)^{-1/2}, \quad w/h > 1$$

$$\Delta L/h = (0.412(\varepsilon reff+3)(w/h+0.264))/(\varepsilon reff - 0.259)(w/h+0.8)$$

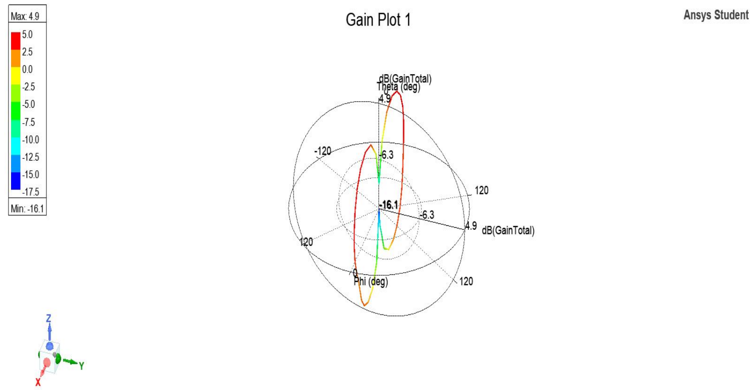
Length (L) of the patch : Calculated using the equation

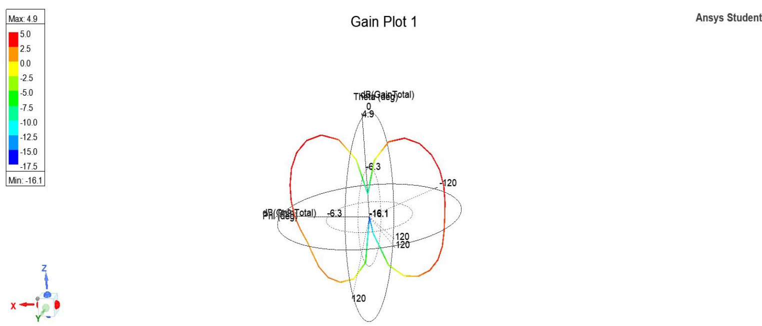
$$L= Co/2fr\sqrt{\varepsilon reff} - 2\Delta L$$

$$Lg+ 6h +L$$

$$Wg = 6h +W$$

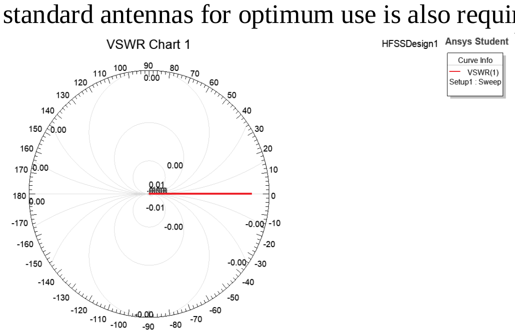
The 3D Gain for the antenna at 5.6 GHz is 5dBi.This implies a good radiation pattern and reduces a structural complexity.

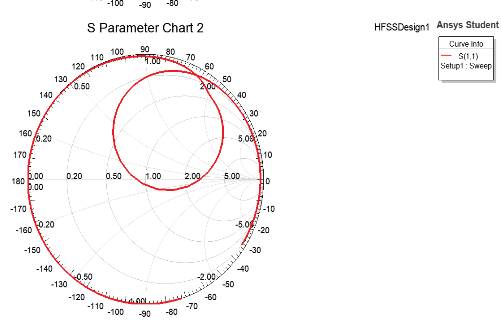


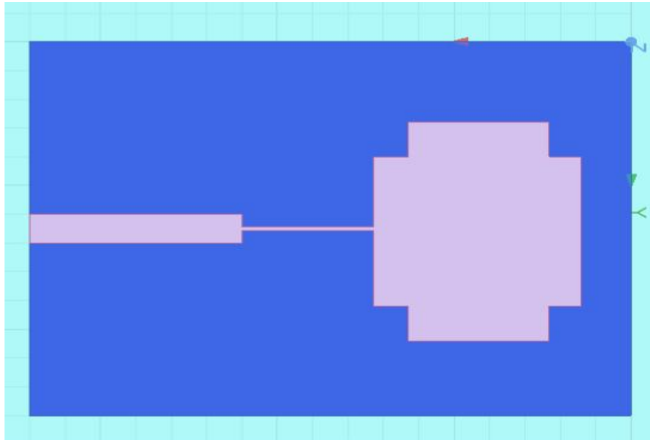


Gain Plot “Fig. 6”,

Microstrip patch antennas are well known for their performance and durable design, manufacturing and design, lightweight, etc. applications in different fields, for example in medical devices, satellites and even military systems, such as rockets, airplanes, missiles, etc. The use of Microstrip antennas is common in all industries and regions, and now their low cost to the substratum and manufacturing is growing commercially. The use of standard antennas for optimum use is also required to take place.



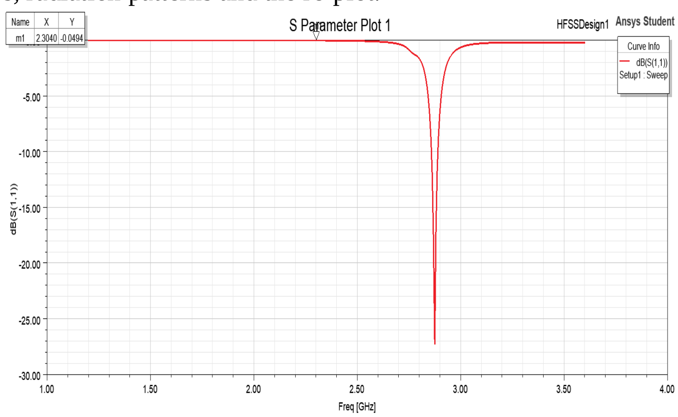




Antenna Front View “Fig. 1”,

III. RESULTS AND DISCUSSION

The return loss of antennas is given by S11. Loss of insertion is proportional to the proportion of the antenna input power. In general, antennas radiate effectively for a limited frequency spectrum. The radiated energy would at these frequencies almost match the input capacity i.e. the reflected power would be very low. The expected S11 plot in the operating frequency range for antenna would therefore be a flat line across the frequency scale with a deep dip. The simulated antenna result is observed by the use of HFSS software for the s parameters, radiation patterns and the re-plot.



S-plot “Fig. 2”,

It is observed that simulated S-parameters of an antenna operating 2.4GHz, which falls below -10dB. The predicted results of the rectangular microstrip patch antenna are presented. Gains are similar to the guidance but are calculation that takes the antenna efficiency and the directional capabilities into considerations. Absolute gain from an antenna in a given direction is known as the ratio of intensity to the radiation intensity in a certain direction, to be obtained if the antenna’s acceptance of power iso-tropically radiated. The intensity of the radiation that represents the radiated power is equal to the power of the antenna divided by 4.

IV. USED PARAMETERS

Dimension of ground plane=85x65
Length of patch=29.44
Width of patch=38.04
Height of patch=1.6
Length of microstrip feed=30
Width of microstrip feed=5
Length of line feed=25
Width of line feed=0.54

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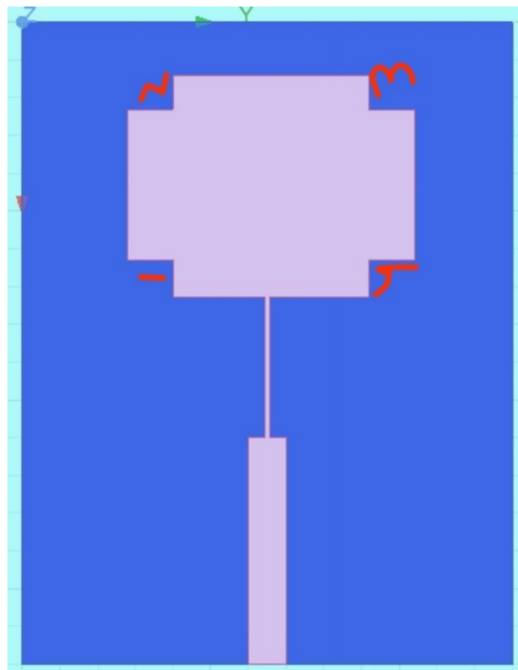
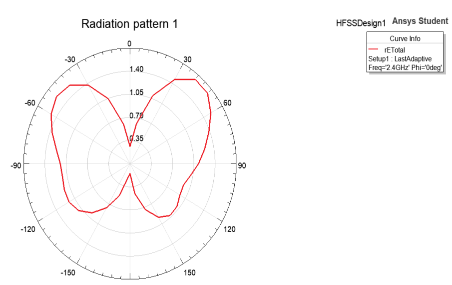
Slots dimension 1= 5x6
Slots dimension 2= 4.5x6
Slots dimension 3= 4.5x6
Slots dimension 4= 5x6
Dielectric constant=2.2
Dielectric material=RT duriod 5880:





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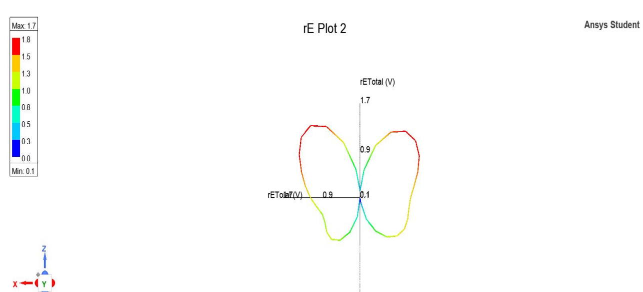
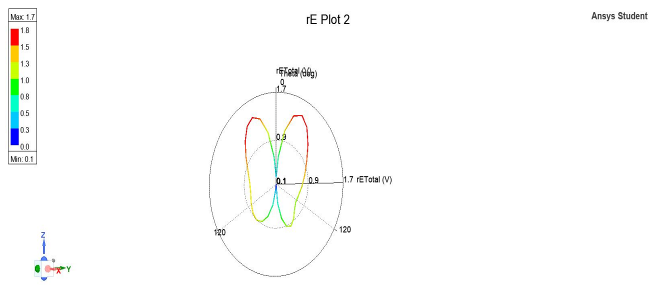
Radiation pattern “fig-3”,



rE-plot “fig-4”,



rE plot "fig-5"

V. CONCLUSION

A thick dielectric substrate with a low dielectric constant is ideal for good antenna performance as this gives better efficiency, greater bandwidth and better radiation. Such a configuration nevertheless leads to a larger antenna size. Higher dielectric constants that are less effective and provide a smaller range must then be used in order to build a compact Microstrip patch antenna.

A balance between antenna and antenna efficiency should therefore be achieved. By integrating a rectangular patch in the Substrate, a microstrip patch antenna can be developed. The antenna for WLAN is conceived for 2.4GHz frequency. The main purpose of this article is to achieve a reasonable pattern of radiation. The antenna proposed is compact and cost-effective. It is simulated and produced successfully for WLAN service. The antenna has been built with the substrate FR4 Epoxy and simulated using ANSYS HFSS

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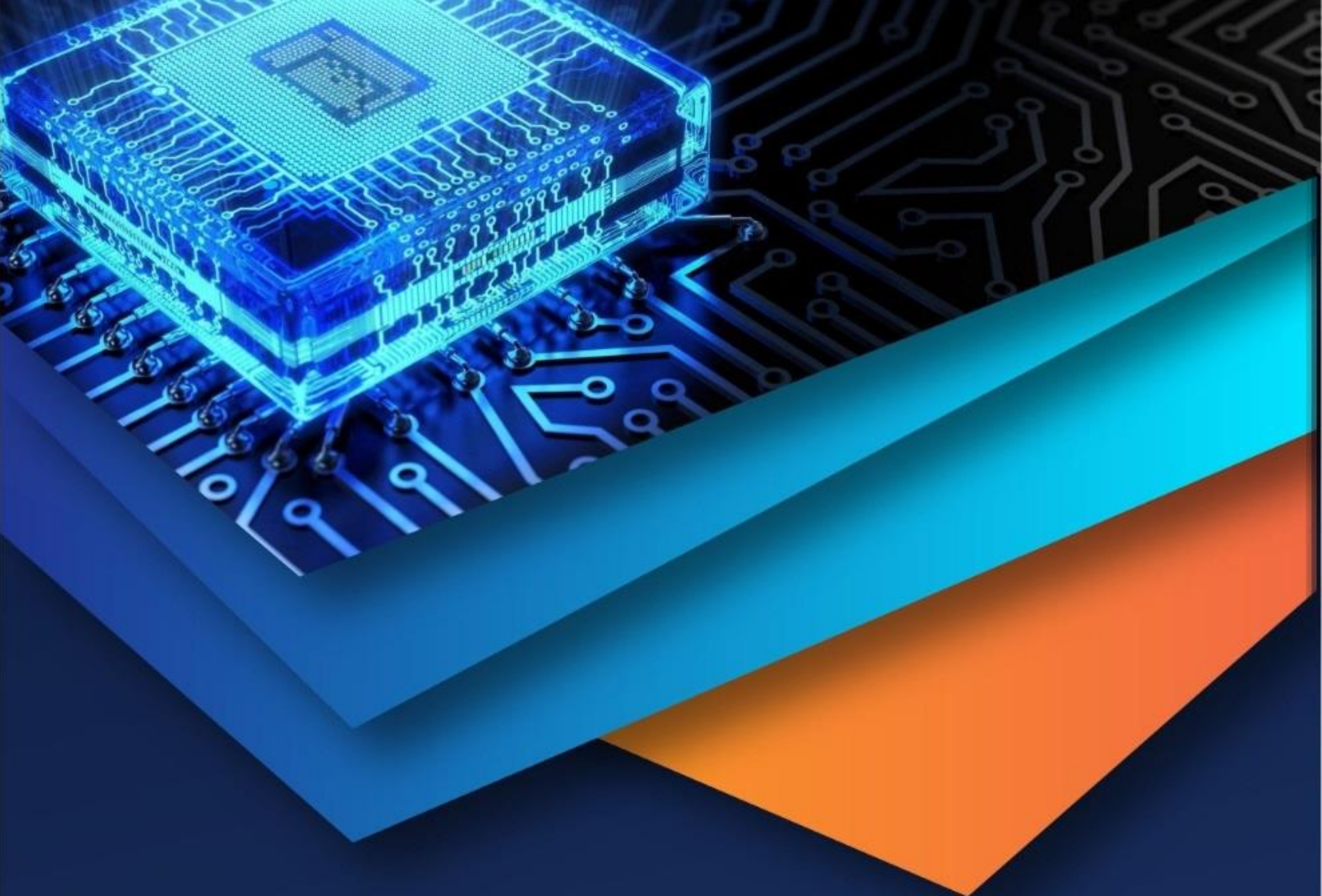

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