Miniaturization of Bow Shaped Microstrip Antenna using Different Substrate

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ABSTRACT
In recent era, the development in communication system requires development of small size electronic system .Now a days, there is demand of small size & low cost microstrip antenna. Microstrip antenna is widely used in wireless communication Applications. Microstrip antenna has small size, low cost, easy in construction & provides high performance over wide band of frequencies. In this paper, we are proposing a new approach for designing a very small size bow shapedmicrostrip antenna. This antenna is used to transmit & receive radio signal at resonant frequency of 3 GHz. At resonant frequency of 3GHz, the antenna concentrates energy through a direction to give a better radiative performance. This antenna is design on different substrate such as roger 5880, roger 5870, benzocyclobuten, epoxy. The effect of these substrates on microstrip antenna is studied & roger 5880 found to be a good substrate to design bow shaped microstrip antenna.

Keywords
Microstrip antenna, Resonant frequency, Roger 5870, Roger 5880, Benzocyclobuten, Epoxy.

1. INTRODUCTION
In wireless communication system, microstrip antenna has wide range of application in spacecraft,satellite,missile application etc. A microstrip antenna have attractive features such as light weight, low volume, low cost, easy to fabricate & easy in construction[1]. A microstrip antenna have capability to provide better performance of radiation. A microstrip antenna has good gain as compared to other antenna because of its ability to concentrate of energy into a tight beam (expressed as narrow beam width) through a direction to provide better performance of radiation [3].

1.1 Basic microstrip antenna
A microstrip antenna is consist of a very thin metallic patch fabricated on dielectric substrate above a conducting ground plane[1]. The metallic patch or radiating patch is made of Cu (copper) & Au (gold) [2]. Microsrtip antenna having different shape like rectangular, circular, triangular, elliptical, ring, disk, square or some other shape. Rectangular& Circular microsrtipantenna are widely used in communication. These microstripantenna have same similarities as these cover a range of frequency from 100 MHz to 100GHz.

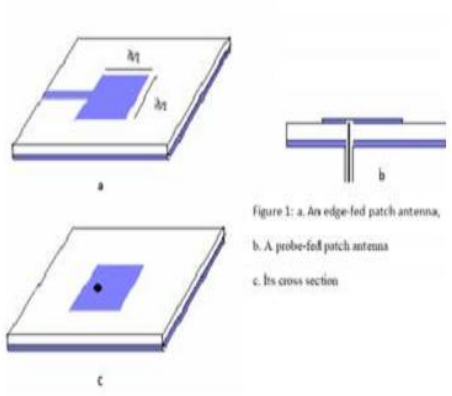

Fig. 1 Mirostrip Patch antenna construction using microstrip fabrication techniques

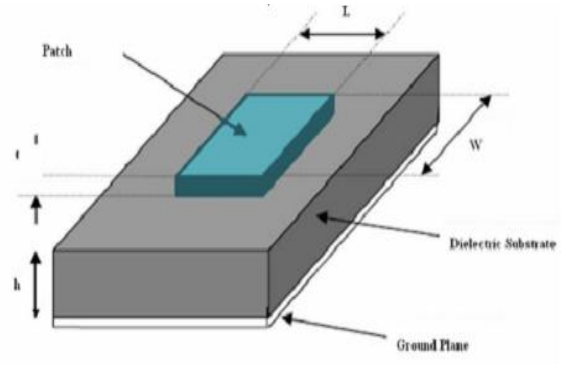

Fig. 2 Constructional view of rectangular microstrip antenna

A microstrip antenna has some disadvantages such as low efficiency, low power, large loss, and poor performances. The losses may be reduced by reducing thickness of substrate. Microstrip patch antenna has various methods of feed lines. A microsrtip antenna having dielectric substrate on one side& patch on other side[2]. The methods of feed line to microstrip patch antenna are microstrip line, coplanar wave guide feed, coaxial probe & proximity coupling[7].

1.1.1 Substrates

Substrate plays a very important role in designing a microstrip antenna. To design an antenna, it is very important to choose a suitable substrate. A substrate is consisting of dielectric material which affects the electrical performance of antenna & transmission line[7]. The size of antenna is depend on dielectric constant of substrate. Generally, high microstrip antenna is used to reduce size of antenna. Some of substrate are ceramic substrates, semiconductor substrates, ferromagnetic substrates (∈= 9 to 16) & composite material subatrates (∈= 2 to 6). Some cermaic substrates have high dielectric constant (∈) in range 20 to 150. Semiconductor substrates are of Si(∈= 11.9) & GaAs(∈= 13.0).

In this paper, we are giving a direction towards the fabrication on different composite material substrate like roger 5870, roger 5880, benzocyclobuten& Epoxy having dielectric constant 2.2, 2.33, 2.6 & 3.6 respectively & effect of these material on resonant frequency of microstrip antenna is studied..

2. DESIGN OF BOW-SHAPE MICROSTRIP ANTENNA

For design of bow- shape microsrtip antenna, following parameter are taken
h=1mm, W=21 mm, L=25 mm, Wcd = Wcp =1 mm,
S1=30.7 mm, D=28.8 mm, Lo =6.6 mm, Wo =1 mm
h= height of patch

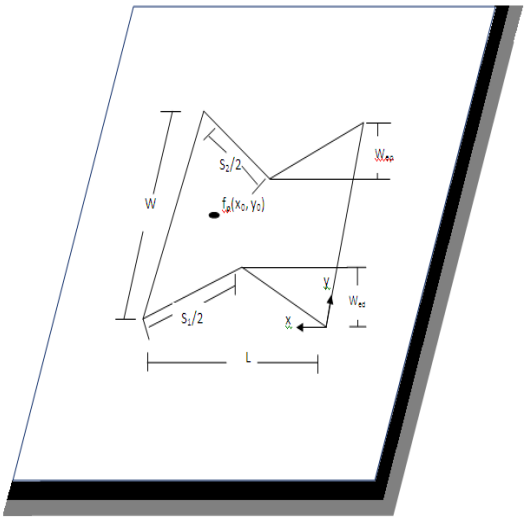

Fig. 3 Constructional view of bow-shaped microstrip antenna

The geometry of the new compact microstrip antenna

W= width of patch
L= length of patch antenna
S1 = slant height of antenna
D=diameter of antenna
∈= Dielectric constant of substrate
C=speed of light=3×108m/s
Ɛ1=effective dielectric constant
Seff=effective slant height of antenna

3. CALCULATION OF RESONANT FREQUENCY

The bow shapemicrostrip antenna is operated in basic TM10 mode and coaxial feed line are used. The resonant frequency (f_{10}) for TM10 mode is calculated by formula given below.

$$f_{10} = \frac{c}{2(S_{eff} + 2\Delta l_1)\sqrt{\varepsilon_1}}$$

$$\varepsilon_1 = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}(1 + 12h/W)^{-1/2}$$

$$\Delta l_1 = \frac{0.412h(\varepsilon_1 + 0.3)(W/h + 0.258)}{(\varepsilon_1 - 0.258)(W/h + 0.8)}$$

For ($L >= W$)

$$S_{eff} = S_1 + 2.3(L - 2W - 0.0046/L)W_{cd} + 0.00006/L - 0.1(W_{cp} - 0.01) \quad \text{for } W_{cd}/W < 1$$

4. EFFECT OF DIFFERENT SUBSTRATE ON RESOSNANT FREQUENCY OF ANTENNA

Bow shape microsrtip antenna having height=1mm, length=25mm & width=21mm, slant height=30.7mm is taken & effect of different material Roger RT 5870, Roger 5870, Benzocyclobuten& Epoxy with dielectric permittivity of 2.2, 2.33, 2.6 & 3.6 is studied & resonant frequency is calculated as shown in table

Substrate Material	Dielectric Permittivity (Ɛr)	Resonant Frequency(f10) GHz
Roger RT 5880 Droid	2.2	3.00
Roger 5870	2.33	2.92
Benzocyclobuten	2.6	2.78
Epoxy	3.6	2.38

5. CONCLUSION

In this paper we proposes a new approach to design microstrip antenna having following benefits:

1. Bow shape mirostrip antenna with substrate Roger 5880 having highest Resonance frequency 3GHz as compared to other substrate microstrip antenna & size of antenna is too small. Hence Roager 5880 is good material for better performance of bow shaped antenna.

2. The proposed result is compared to a rectangular patch microstrip antenna with the same dimensions and substrate.It is found that Bow shaped antenna gives higher value of resonant frequency than a rectangular patch microstrip antenna.

3. The overall area of the microstrip antenna is reduced greater than 65% for TM_{10} mode frequency as compare to a rectangular patch microstrip antenna

6. REFERENCES

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