

Microstrip Patch antenna for ISM band applications

Waghmare G. B.

Communication Research Laboratory,
Department of Electronics,
Shivaji University, Kolhapur-416 004, India
email: eln.ganesh@gmail.com

Bhanarkar M. K.

Communication Research Laboratory,
Department of Electronics,
Shivaji University, Kolhapur-416004, India
email: mkb_eln@unishivaji.ac.in

Abstract - The patch antenna is very much useful in the field of advanced wireless communication systems, because of their small size, low weight, low cost, high gain and directional radiation pattern. Patch antenna can be design in any shape and generally takes a size as small as possible. The small size patch antennas are needed because of modern telecommunication equipment whose size and weight is reduced. Square type patch antenna is mostly used because of ease of fabrication, analysis, radiation characteristics and low cross polarization, the same square type patch antenna is mentioned in this paper. The most important characteristics of patch antenna are its gain and frequency range over which it operates, the given patch antenna is designed on these two deciding factors. The designed antenna is operating at 2.4 GHz frequency range, which is used as free frequency band or ISM band. The microstrip feed line method and the FR4 substrate have been used for mounting the patch element. ANSOFT design software is used for method of moment.

Keywords- Microstrip antenna, ISM band, FR4, ANSOFT design SV2.

I. INTRODUCTION

Globally in all wireless application antennas is basic and most important unit. Microstrip patch antenna will be fit for the appreciated application. Patch antenna is the best solution for small size portable equipment because of its small size, high gain, low profile, low cost [1,2]. Patch antenna consist of metallic patch on the top of the dielectric substrate below which ground plane exists. There are number of substrate that we can use for the design of microstrip antenna for e.g. Alumina, FR4, RT-duroid etc [2], having dielectric constants in the range of 2.2 to 12. For the good antenna performance, we must need low dielectric substrate in order to provide better efficiency [3]. The microstrip feed line method is used to feed the patch antenna because of its impedance matching capability [4]. The patch antennas are mostly used in satellite, radar, spacecraft, GPS and GSM [5-6-7].

II. ANTENNA DESIGN

The main aim of the proposed work is to design small size patch antenna for wireless embedded applications, for that the plane square shape patch antenna is chosen in order to reduce complexity and it can easily fit in the device. The substrate used for the antenna design is FR4 ($\epsilon_r = 4.4$, 0.060, inch, 0.5 oz copper) dielectric material because of its ease of availability and moderate dielectric permittivity. The height of dielectric material is chosen to be 1.5mm which is default size of FR4 material. The width of conducting patch element is 46mm and length is 32 mm for the frequency of 2.4 GHz. The most important element is feeding the strip for connecting the probe to the antenna for that microstrip feed line method is used for better impedance matching having the width 5 mm and length of 29 mm, which is attached at the square path antenna as shown in fig 1.

For the excitation 2 GHz frequency is given to the antenna, and also applied two frequency sweeps i.e. one is for interpolating having starting point at 1 GHz and stopping

point at 5 GHz for the steps of 200 is given for simulation. Another sweep is for generating surface current having starting point at 1 GHz and stopping point at 5 GHz.

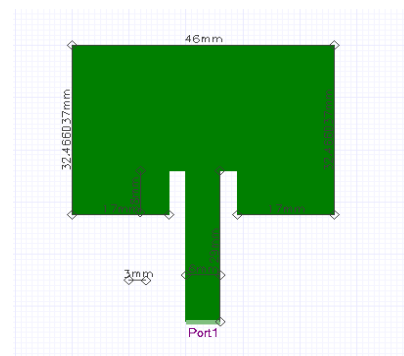


Fig. 1 Square patch antenna

III. RESULTS AND DISCUSSION

Present antenna design simulation is done using ANSOFT simulink SV2 software which is based on method of moment.

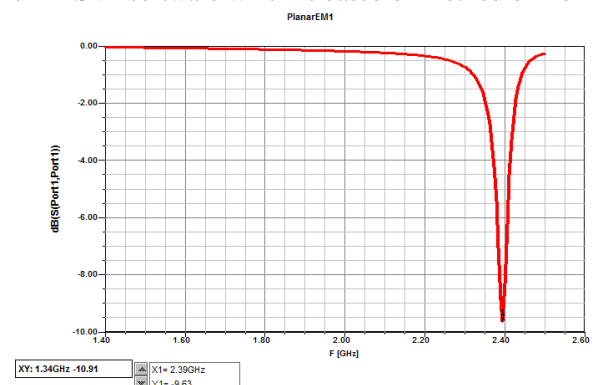


Fig. 2 Return loss

After simulation the results shows that given antenna resonate at the expected frequency of 2.4 GHz in fig.2.

The figure 2 shows the return loss (S11) parameter of antenna. The antenna is resonating at 2.4 GHz having return loss of -9.63.

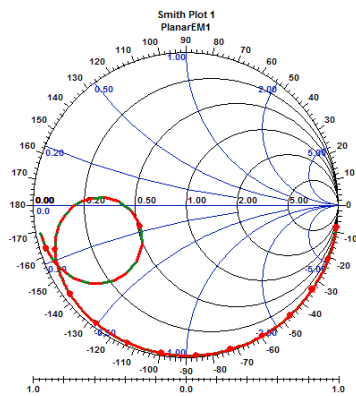


Fig. 3 Smith chart

Smith chart indicates the impedance matching of antenna at 2.4 GHz; also it indicates the resistive, inductive and capacitive fields of antenna. From figure 3 we can conclude that antenna meet resistive field at 2.4 GHz.

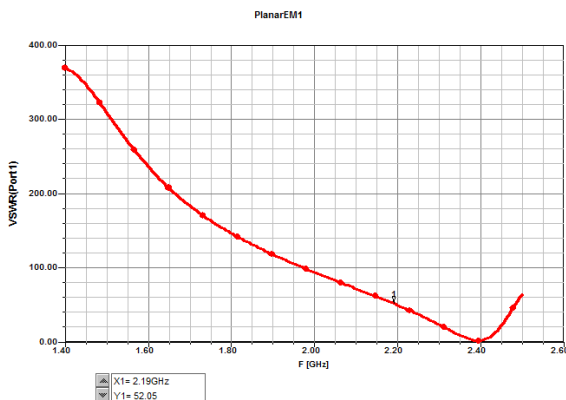


Fig. 4 VSWR

VSWR is also one of the important characteristics of antenna, it indicates better matching of antenna at given frequency band. From figure 4 it seems that antenna has VSWR of 1.9 at 2.4 GHz.

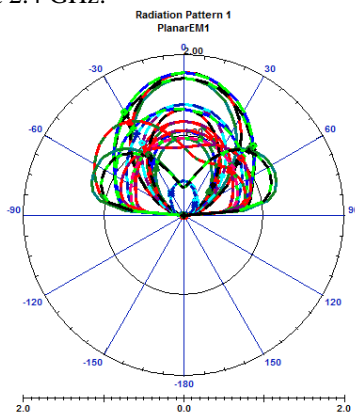


Fig. 5 Radiation Pattern

Radiation pattern defines of power radiated by antenna as a function of direction away from the antenna. Fig 5 shows the

present patch antenna has directional radiation pattern which require for most of the wireless applications. The different curves in above figure indicates antenna directional pattern for the frequency band of 1 GHz to 2.5 GHz.

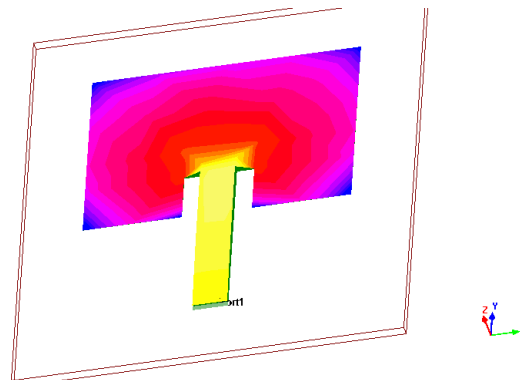


Fig.6 Current Distribution

There must be a current distributed throughout the patch element continuously. The above figure 6 shows the antenna current distribution at 120 degree and at 180 degree, where current distribution with normal to antenna is occurred simultaneously.

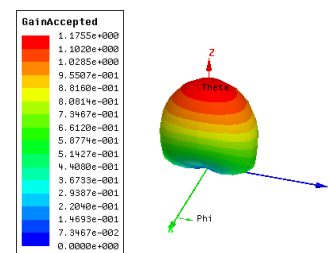


Fig. 7 3D Gain

Antenna gain describes how much power radiated in the desired direction to that of an isotropic antenna. From figure 7 we can see that gain accepted by given antenna is 1.175 dB.

CONCLUSION

In present paper square shape patch antenna for ISM application is simulated. Small size and low dielectric substrate makes the antenna compatible for portable wireless equipment. Designed gain, radiation pattern and return loss obtained are good enough to make antenna for use in radar application.

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