

Design of 915 MHz Monopole Antenna for ISM Applications using CST

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Abstract – This paper is mainly describes the designing and simulation of PCB monopole antenna for Industrial Scientific Medical (ISM) band resonant frequency of 915 MHz. The design and simulation is done by using CST software. For many applications large bandwidth is required, for various planar configurations such as circular, triangular, rectangular and square monopoles have been studied. The square monopole provides smaller BW than the circular monopole, its radiation pattern suffers less degradation within the impedance BW. It has been observed that rectangular monopole antennas are small in size and simple in design and fabrication because of low operating frequency but its performance is very good for ISM band and multiband applications.

Key Words: ISM Band, PCB Monopole Antenna, CST, Square Monopole, Rectangular Monopole.

1. INTRODUCTION

The Wireless communication systems are becoming increasingly popular. However, the technologies for wireless communication still need to be improved further to satisfy the higher resolution and data rate requirements. In the communication system the more things to look its cost and low power device and it is the monopole which previous things is used and still be improve for the communication system.

A regular feed for the monopole antenna is a coaxial line with its inward conductor associated through a gap in the ground plane to the vertical monopole component and its external conductor associated by methods for a spine to the ground plane. Normally, the internal conductor's distance across is equivalent to the monopole component's measurement and the external conductor's breadth is equivalent to the ground plane opening width.

The least complex individual from the family is the quarter wave monopole over a perfect ground plane. The impedance BW achievable for the quarter wave monopole antenna is subject to the range of the round and hollow stub and increments with expanded sweep. A planar monopole might be acknowledged by supplanting the wire component of an ordinary monopole with a planar component. The planar component is situated at a separation 'h' over the ground plane. The supplanting of wire component with planar component, with different shapes, expands the surface regions of the monopoles, there by directly affecting BW.

2. ANTENNA STRUCTURE

Design of monopole antenna based on the basic parameters of resonant frequency range is 902-928 MHz, relative permittivity of monopole antenna Substrate is 4.5 and height is 135 mm. Width and Length of monopole antenna are respectively 0.3 mm and 130 mm.

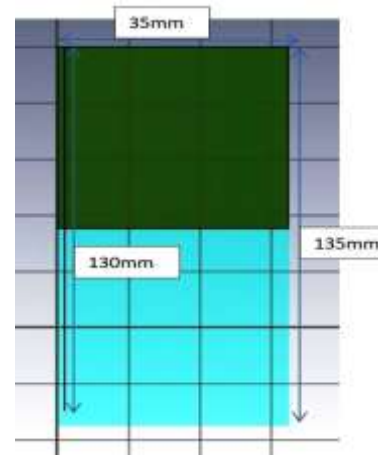


Figure 1: Geometry of Monopole Antenna

The design has been simulated by using CST software, which is a full-wave electromagnetic field simulation package. The total size of the substrate is 135mm x 35 mm including ground plane with the height of 0.8 mm. monopole has been investigated for the ISM band antennas in the wireless communication systems. Design dimensions of monopole antenna structure are shown in Fig. 1. Ground plane is kept on the other side of an antenna. The antenna is fed by 50 Ohm feed line.

3. METHODOLOGY

1. Calculation of Dimension: Dimensions of monopole antenna is calculated by theoretical method according to the operating frequency and required bandwidth and gain.

2. Design of Antenna: According to the dimensions and parameters calculated in above step monopole antenna is designed by using CST software.

3. Simulation: Simulate the above designed antenna by using the Computer Simulation Tool(CST and observe the various parameters such as current distribution, radiation pattern, gain v\s frequency plot, VSWR, return loss etc.

4. Observation: Observe the results and various parameters obtained in the above step and check whether the required parameters and operating frequency is achieved or not, if not then again vary the parameters, dimensions and shape of monopole antenna and then design and simulate the structure again for observations as in step 2 and 3.

5. Hardware Implementation: If the desired parameters and results are satisfied then implement the structure on PCB, design monopole antenna structure as per the design in the software.

6. Observation of Hardware Results: After implementing the structure on PCB analyze the result and observe whether the desired parameters are achieved as in the CST software design.

4. SPECIFICATIONS

The three main parameters for the design of a rectangular patch antenna are as follow:

i). Operating frequency (f_0): The resonant frequency of the antenna must be selected appropriately. The ISM Band frequency ranges from 902-928 MHz. Hence the antenna designed must be able to operate in this frequency range. The resonant frequency selected for our design is 915 MHz.

ii). Dielectric constant of the substrate (ϵ_r): The dielectric material selected for our design is FR4 which has a dielectric constant of 4.5. A substrate with a high dielectric constant has been selected since it reduces the dimensions of the antenna.

iii) Substrate height (h): For the rectangular monopole antenna to be used in ISM band applications, it is essential that the antenna is not bulky. Hence, the height of the dielectric substrate is selected as 0.8 mm.

5. RESULTS

The described Antenna is designed and simulated in Computer Simulation Tool (CST) and simulated results are given below

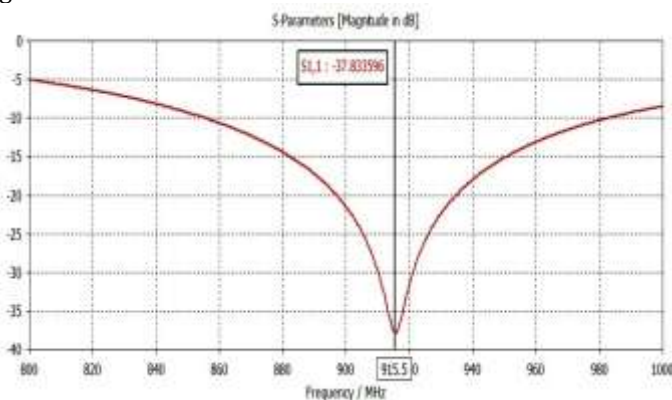


Figure 2: Return loss of Monopole Antenna

As seen in Figure 2, S-parameter of monopole antenna is measured, the s11 value is measured designed antenna is -37.833 dB ranging from 902 MHz to 928 MHz. The designed antenna is having wider bandwidth ranging from 855 MHz to 980 MHz. The radiation pattern of the proposed antennas was also measured as receiving antenna was located at different angles.

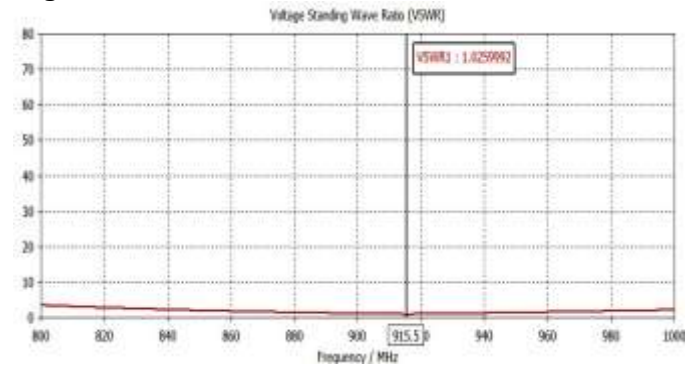


Figure 3: VSWR of Monopole Antenna

The figure 3 shows the VSWR of monopole antenna and it measure 1.025 at 915 MHz. the full band of monopole antenna is measures less than 2.

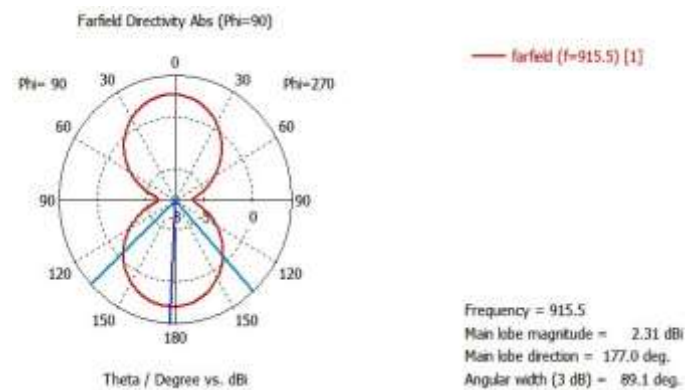


Figure 4: Polar Gain Plot of Monopole Antenna

The figure 4 shows the polar gain plot, The gain of the described antenna is measured using radiation pattern simulation. It is noted from the graph, the gain of the antenna is 2.31 dBi.

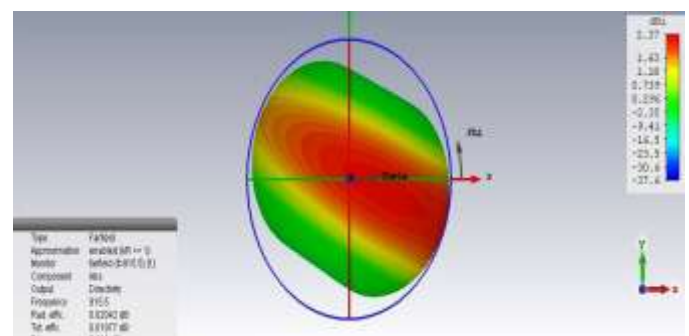


Figure 5: 3D Plot of Monopole Antenna

The 3D view of the monopole antenna is shown in figure 5. The parrot green color field shows the simulated gain and the red colour field shows the measured gain which is of 2.31 dBi.

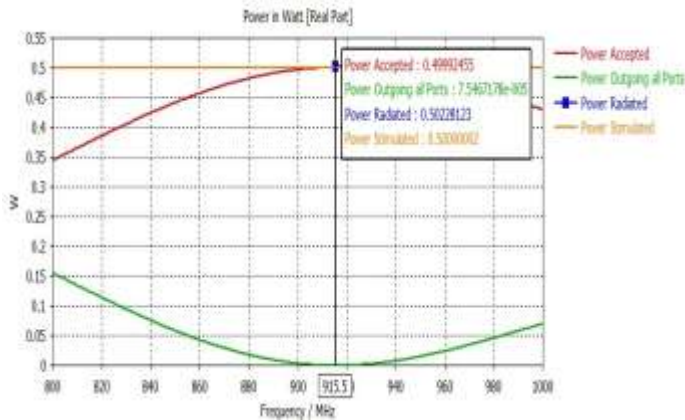


Figure 6: Power Plot of Monopole Antenna

The power plot of monopole antenna is shown in figure 6.

The red colour line in the plot indicates the power accepted which is of 0.499924 watt, the green colour line describes the outgoing powers through the ports is around 7.5467 watt. The blue colour line indicates the radiated power, the radiated power in the plot is 0.502281 watt and stimulated power is 0.5 which is denoted by orange colour in the plot.

6. CONCLUSION

The Rectangular monopole antenna was designed in computer Simulation Tool (CST) for ISM band applications and it exhibits high gain for the frequency range from 902 MHz to 928 MHz with a center frequency of 915 MHz. The size of monopole antenna is kept small considering its use in wireless systems and wireless devices. This antenna is mainly designed and suitable for ISM band applications. This antenna can be further extended to dipole antenna with a multi band frequency feature for ISM applications.

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