BROADBAND DUAL POLARIZATION ANTENNA ARRAY FOR WIRELESS SENSOR NETWORK (WSN) APPLICATIONS

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Abstract

A Microstrip patch antenna is an effective antenna for the present trend of applications in wireless communication. The Project is emphasizing on the design of a multiband antenna and intending to existing wireless services like GPS, GSM, PCS, DCS, & UMTS bands. The present system methodology includes the modification of the main radiator via distorting, overlapping, zigzag, and enfolding. This advance offers different advantages, depending on the mandatory application. This antenna patch involves one T-Slot, two E-Slots and it is designing in HFSS tool to attain high gain, less return loss, and so on. Here, we are using feeding techniques like microstrip feedline&coaxial feedline. Thus, these antennas are compact and have multiband capability can be encouraging candidates for many wireless applications. Now, this slot multi-band planar system is proposing to intend work on frequency bands such as in GPS, WLAN, and Wi-MAX.

Keywords: Microstrip Patch Antenna, HFSS Tool, Microstrip Feed Line & Coaxial feedline, T-Slot, E-Slot.

1. Introduction

In this modern technology, Antennas playing an important role in the operation of all radio equipment in the communication field. An Antenna can be operated either as a transmitting antenna or a receiving antenna. The transmitting antenna converts electrical signals into electromagnetic waves and radiates them and receiving antenna converts electromagnetic waves into electrical signals. The design is implemented using a Microstrip patch antenna on which FR 4 substrate is etched using both microstrip feedline and coaxial feedline. It has advantages that will provide good antenna performance, better efficiency, better radiation, and large operating bandwidth. It can be used in rectangular, square, triangular, etc. are easily etched. They support dual-polarization types like linear and circular both and in the proposed system, we are using circular polarization. In the proposed system, both the microstrip feedline and coaxial feedline is used on which the microstrip line consists of the dielectric substrate on which one side is a pattern and a ground plane on the other side of it. A microstrip feed line is a type of feedline in which a metallic microstrip feed is directly connected to one side of the microstrip patch. The main advantage of this technique is that the feed is placed on the same plane as the patch, so it is easy to fabricate. Coaxial feedline is a very common feed technique and is used in microstrip patch antenna. The antenna is designed and simulated in HFSS (High-Frequency Structural Simulator) design software Tool. HFSS is a commercial finite element method solver for electromagnetic structures from Ansys. HFSS Tool is a commercial tool used for antenna design, and the design of complex radio frequency, electronic circuit elements including filters, transmission lines, and packaging. The simulation output is for verification of results which can be shown in HFSS Tool.

2. Related works

S. W. Su et al [2] have proposed a three-antenna system suitable to be concealed inside wireless access points and it has poor gain, difficult to design, and very narrow because they used three dual-loop antennas and this can be used only in two bands but in our proposed system, we are using microstrip patch antenna which is small in size and eases to design a compact antenna. The existing system gives coverage up to 120 degrees only but in the proposed system, it gives coverage for a full 360 degrees.

S. W. Cheung et al [1] have proposed a planar dual-band monopole antenna with a frequency-tunable band. Here, it can be used to generate two frequency bands and they are using an L-shaped stub which produces less gain and high return loss. In our proposed system, the antenna can be used for five frequency bands and we are using one T-shaped and two E-shaped stubs. By using a microstrip patch antenna, it produces high gain and less return loss.

T. Itoh et al [3] have proposed compact patch antennas loaded with complementary split-ring resonators (CSRRs) and reactive impedance surface (RIS). It is difficult to design because of using a compact patch antenna. In the proposed system, it is easy to design by using a microstrip feedline and a coaxial feedline on a microstrip patch antenna.

L. C. Lee et al [5] have introduced a multiband printed monopole slot antenna for operating as an internal antenna in the thin-profile laptop computer. Because of using monopole slot antenna, they are larger in size at a lower frequency and it is difficult to design them for frequencies less than 433MHz. In the proposed system, we are using one T-slot and two E-slots on a Microstrip patch antenna so it is easy to design and can be used in high frequency.

3. Proposed Method

The Proposed system of the antenna supports the optional MIMO feature specified in the WiMAX standard. In which, each frequency band generates using a strip/slot. In the proposed four-band antenna, we use the harmonics of the T-shaped feed patch to generate two frequency bands. Then, by using a double-folded stub in the T-shaped feed patch, the two harmonic resonant frequencies can be tuned independently. With this method, the slot antenna can have four operating bands, and the radiating portion of the proposed system of the antenna has a compact size of $0.43\lambda g \times 0.17\lambda g$ gains of the antenna in the four frequency bands are much higher gains than those of the five-band antenna. The proposed multi-band antenna is studying and designing using the EM simulation HFSS Tool. The methodology used to design the antenna for other frequency bands is also including in proposed system. For verification of simulationresults, the antenna is fabricating and measuring using the antenna measurement equipment at 1.575 GHz, 2.45 GHz, 3.5 GHz, and 5.4 GHz. It is capable of working in 5 frequency bands and for 4 applications as built-in by one antenna. The miniaturization is done in various stubbed arms that two E-shaped stubs and a T-shaped stub designed optimistically to achieve the minimal return loss over the four bands of the frequency spectrum and the MIMO based multi-channel propagation technique.

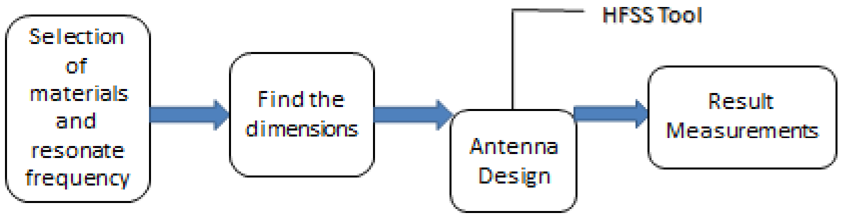

Figure 3.1 Block Diagram of Process of the System

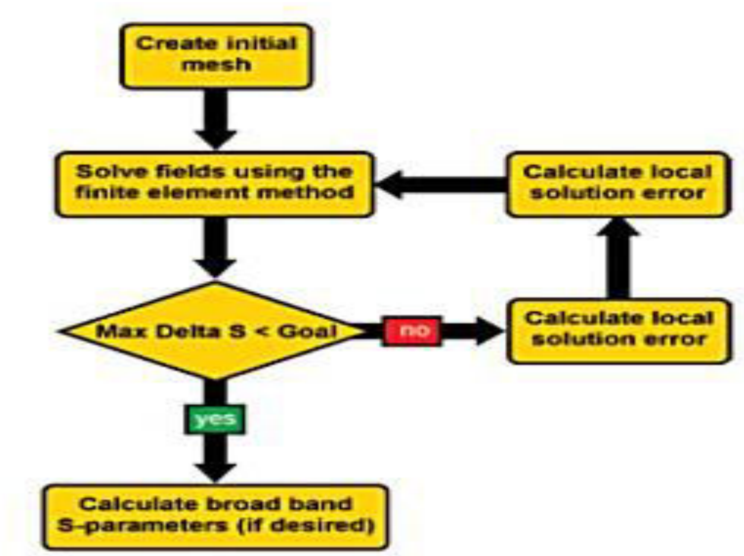

Figure 3.2 Flow Diagram of Simulation Process

The above figure 3.1 is the process of our proposed system. The selection of materials is FR 4 substrate as a dielectric, two E-Slots, and one T-Slot at 2.4 GHz resonant frequency on circular polarization. After finding dimensions, the antenna is designed with dielectric thickness is 0.8mm, permittivity: 2.4, loss and tangent: 0.24 in HFSS tool for simulation, and via simulation the results of VSWR, Return Loss, Radiation Pattern, Gain are measured for verification. The figure 3.2 explains the simulation process of proposed system. Advantages of proposed system are Continuous frequency ratios can be implemented by changing the antenna dimensions, Small size, low loss, Wide triple band usage, First tablet antenna to implement all the LTE bands. Applications of proposed system are Large no of LTE system band compatibility, High data rate services, Mobile TV applications, Secondary network exploitation capacity, Compatible to cognitive radio network system implementation.

4. Resultsand discussion

The results and discussion obtained by the proposed Microstrip Patch Antenna using FR 4 substrate in High Frequency Structure Simulator (HFSS) Tool.

4.1 Experimental setup

In this section, we estimate performances of the proposed method, HFSS Tool used for Simulation and for verification.

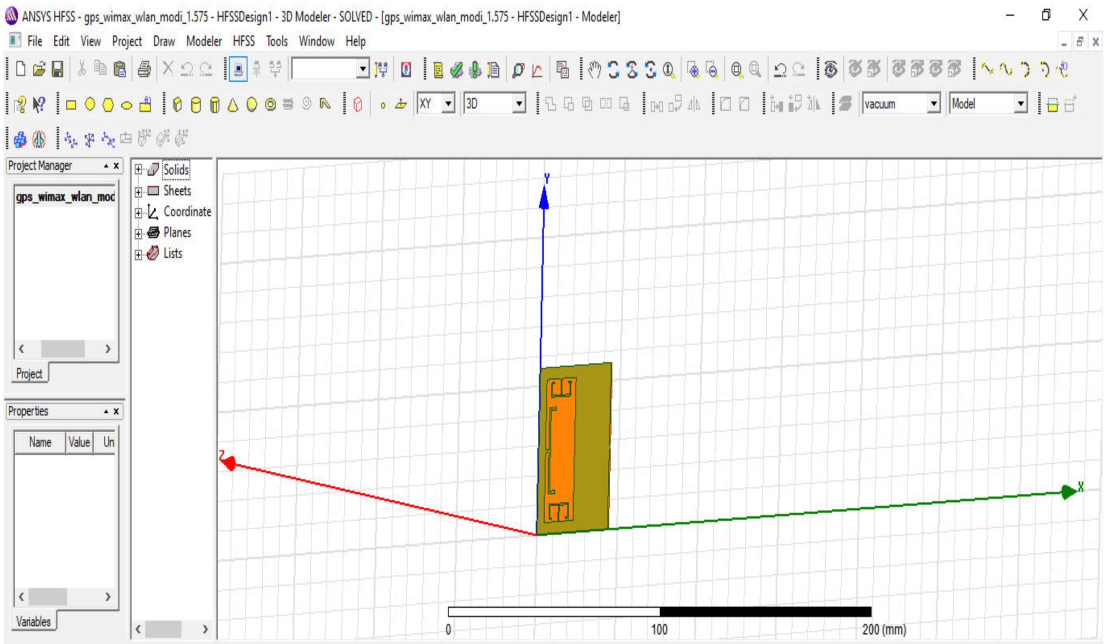

Figure 4.1 Front View of Rectangular Antenna Design

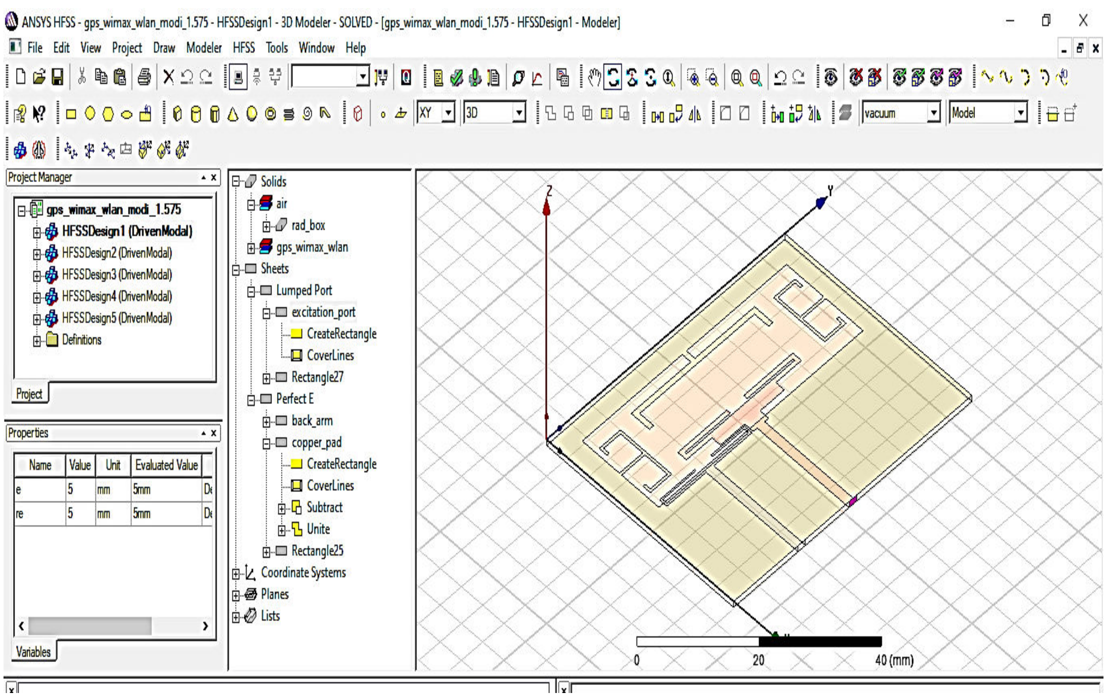

Figure 4.2 Top View of Rectangular Antenna Design

TheFigure 6.1 and Figure 6.2 shows the front and top view of the designed rectangular antenna in which it is designed using one T-shape and two E-shape slots.

4.1.1 Simulation Output of VSWR

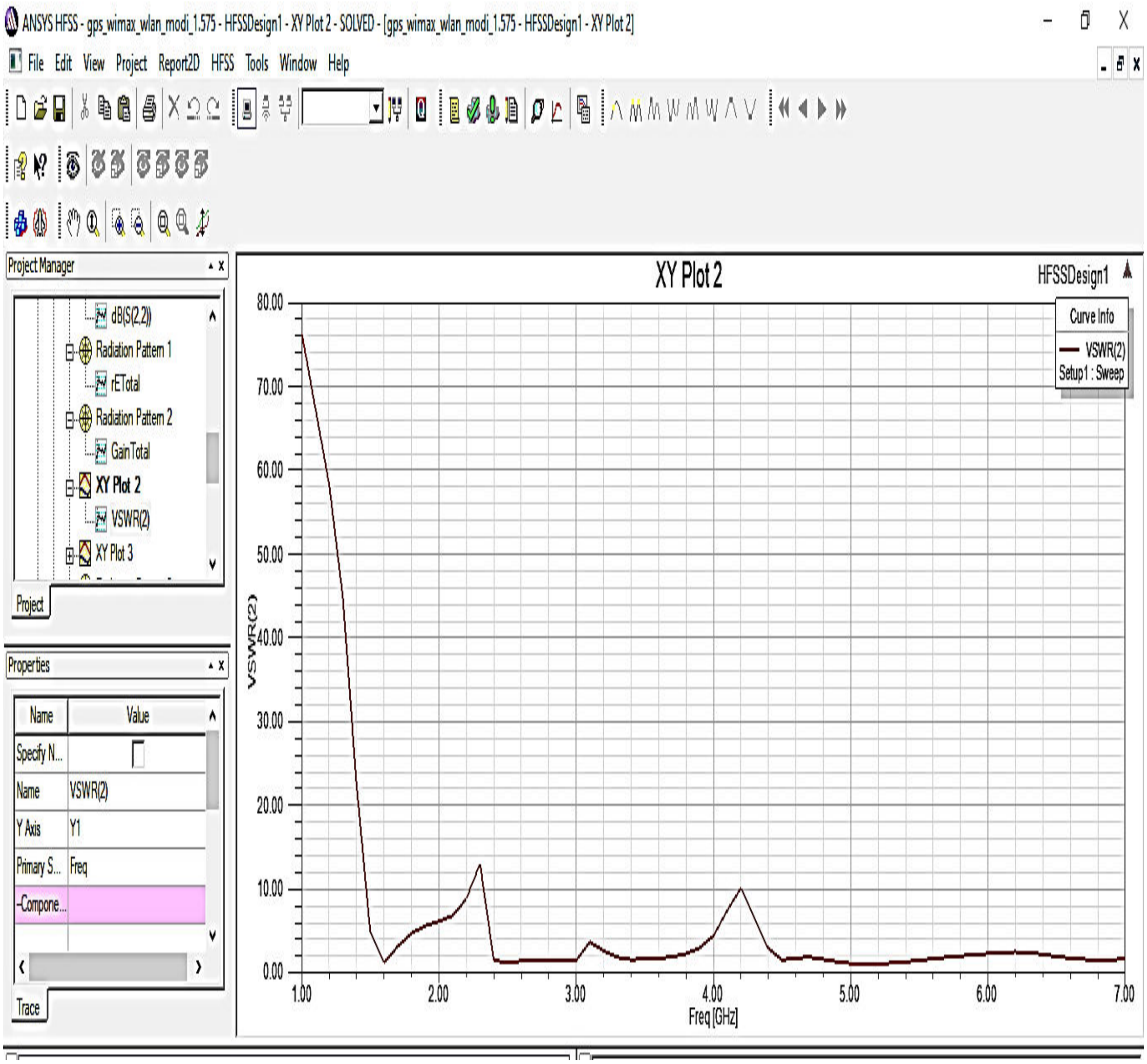

Figure 4.3 Simulation output of VSWR

The Figure 4.3 shows the Simulation output of VSWR is a voltage standing wave ratio in a transmitting line and is a wave in which the dispatch of current, voltage, or field strength is formed in opposite directions by the overlaying of two waves of the same frequency propagating. Then the voltage along the line produces a series of nodes and antinodes at fixed positions.

4.1.2 Simulation Output of Gain

Gain is the magnitude of the potential of the antenna is to direct the input power into radiation in a certain direction. Here, Gain is attained by directing the radiation away from otherparts of the radiation sphere. In general, the gain is defined as the gain-biased pattern of the antenna.

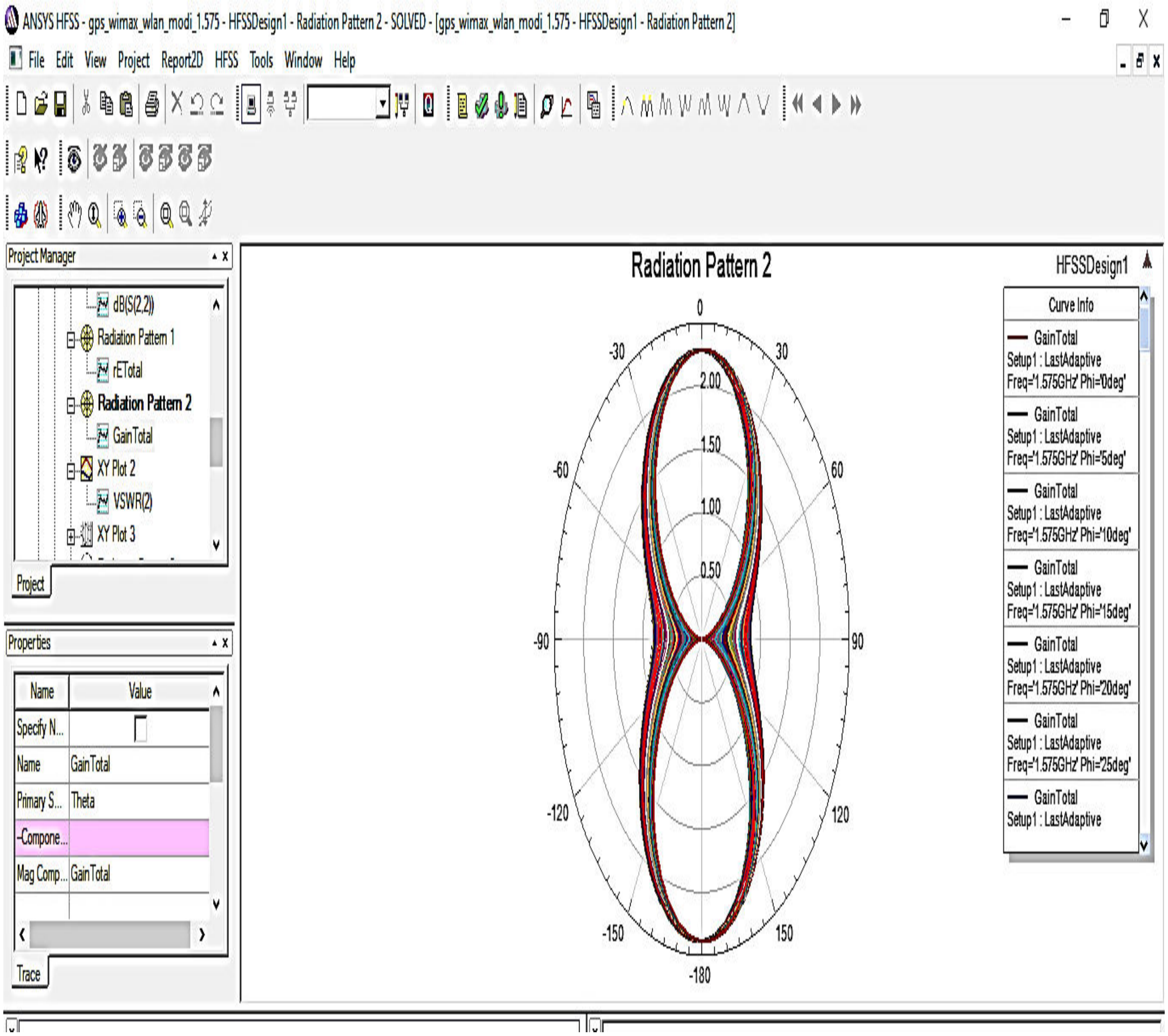

Figure 4.4 Simulation Output of Gain Pattern

Gain is measured at the peak radiation intensity and its simulation output is shown in Figure 4.4.

4.1.3 Simulation Output of Radiation Pattern

The radiation pattern is a design of the far-field radiation properties of an antenna and a similar to the function of the spatial coordinates which is expressed by the azimuth angle (φ) and the elevation angle (θ). Especially, it is a plot of the power radiated from an antenna per unit solid angle which is merely the radiation intensity which is shown in figure 4.5. It can be plotted as 2D polar or as a 3D graph or Cartesian slice of this 3D graph. It is an extraordinary parameter as shown in the antenna's directivity besides gain at assorted points in space.

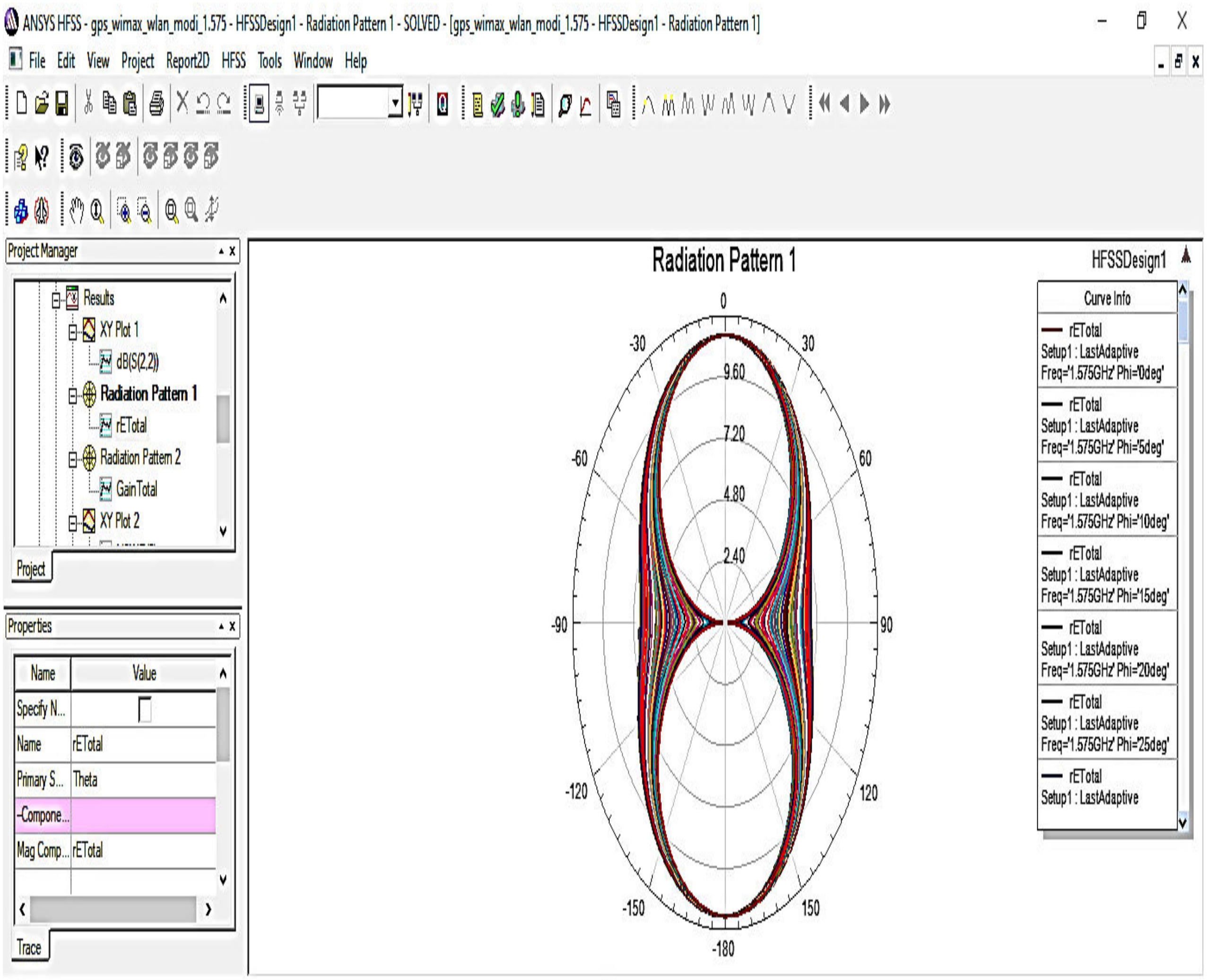

Figure 4.5 Simulation Output of Radiation Pattern

4.1.4 Simulation Output of Return Loss

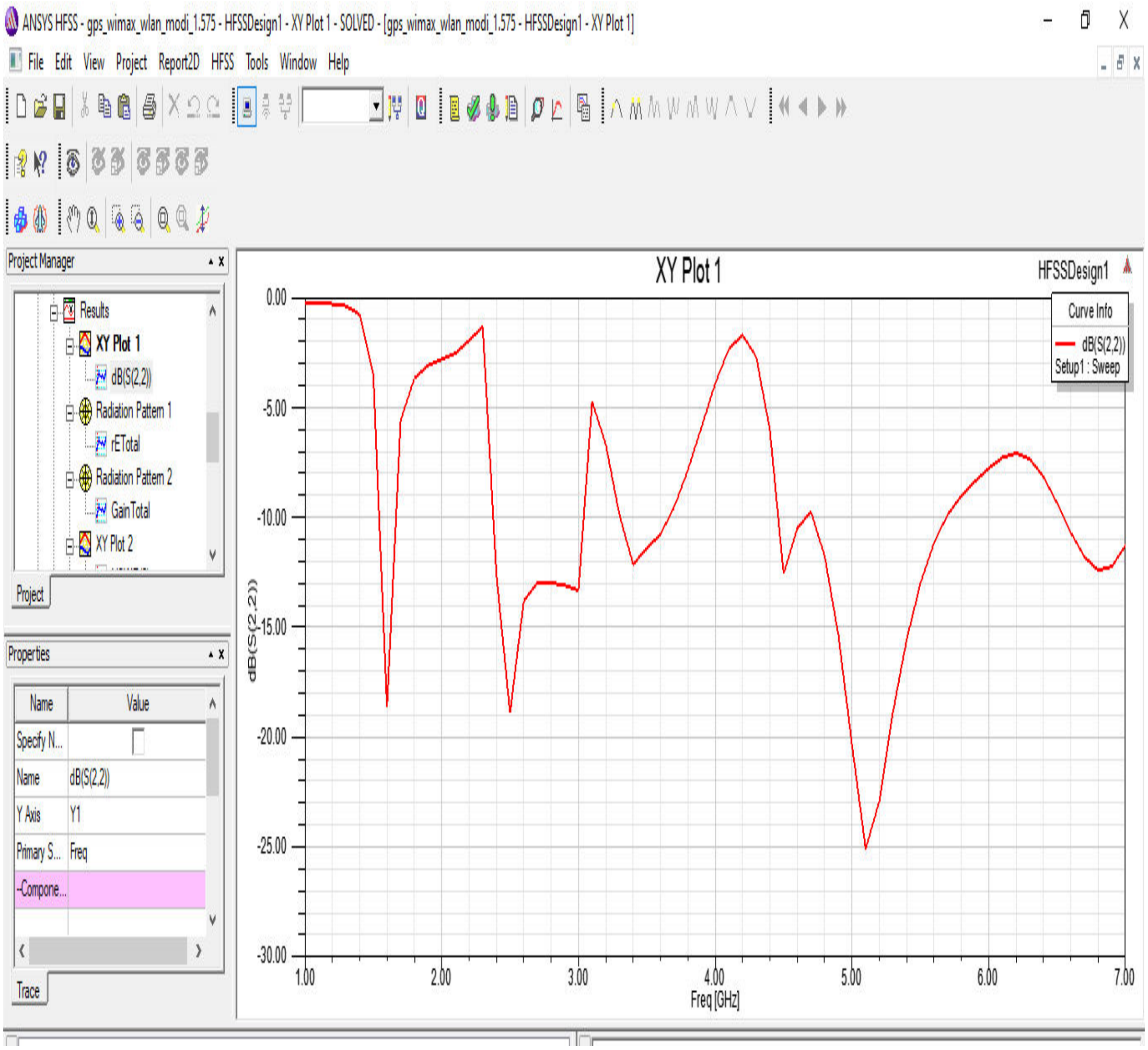

Figure 4.6 Simulation Output of Return Loss

Figure 4.6 shows the output of Return loss which is dropping the power in the signal reflected by a disruption in a transmitting line or optical fiber. The interruption can be a mismatch with the terminating load or with a device inserted in the transmission line. Return loss is phrased as a ratio in decibels (dB).

5. Conclusion

A Microstrip patch antenna in the radiator and partial ground plane has been designed and simulated. The proposing antenna exhibit five bands and supports 2.4 GHz, 3.5GHZ, 5.3 GHz, and 5.8GHz as well as good radiation properties. Therefore, this antenna suitable for Super High-Frequency application is other wireless applications that work in these frequencies. Patch antenna for multiband frequency applications with MIMO technique is simulated.

References

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