CPW Feed Patch Antenna for GPS Applications

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Abstract
In this paper we are proposing a CPW-Fed patch antenna. This paper presents the design of rectangular patch microstrip antenna for the frequencies at L1 (1.67 GHz to 1.90 GHz) and L2 (2.65 GHz to 3.05GHz). The simulation is done by using the HFSS software, which is a full-wave simulation tool, based on the method of moments The bandwidth of the proposed antenna reaches about 230MHz & 400MHz with the return loss of about -30dB & -28dB respectively over the chosen frequency spectrum.

Keywords: CPW-Feed, Microstrip Patch Antennas, Radiation Pattern, Return Loss.

Introduction
The GPS (Global Positioning System) has revolutionized navigation and position location. It is now the primary means of navigation for most ships and aircraft and is widely used in surveying and many other applications like tracking, mapping, and determining the location. With the advancement of technology, GPS is now been widely used by the public for their navigation purposes. The main reason for its increase in demand is its light weight, compact in size and most important it has low cost with high precision and reliability.
This high demand for GPS has prompted the antenna designers to increase the investigation on Microstrip radiators, with particular attention paid to improving performance and miniaturization. Microstrip antennas have enjoyed proliferate use in many circularly polarized applications due to their low-profile light weight and useful radiation characteristics.
A Microstrip or patch antenna is a low profile antenna that has a number of advantages over other antennas it is lightweight, inexpensive, and easy to integrate with accompanying electronics. While the antenna can be 3D in structure (wrapped around an object, for example), the elements are usually flat; Hence their other name, planar antennas. Note that a planar antenna is not always a patch antenna. The following drawing shows a patch antenna in its[1][5] basic form: a flat plate over a ground plane (usually a PC board). The center conductor of a coax serves as the feed probe to couple electromagnetic energy in and/or out of the patch. The electric field distribution of a rectangular patch excited in its fundamental mode is also indicated.

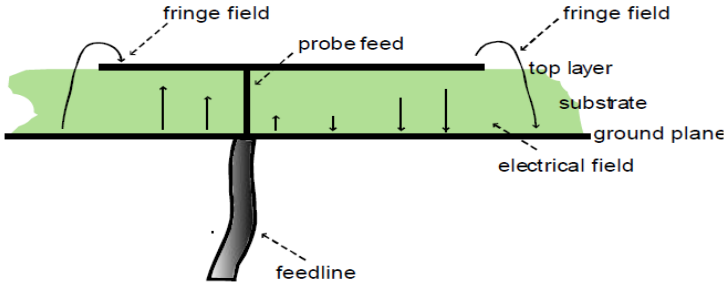

Figure.1 Patch Antenna in Basic Form

The electric field is zero at the center of the patch, maximum (positive) at one side, and minimum (negative) on the opposite side. It should be mentioned that the minimum and maximum continuously change side according to the instantaneous phase of the applied signal. There are several methods to connect the radiating patch to feeder which are coaxial cable, Microstrip line feed, aperture coupled feed and the proximity coupling feed. Impedance matching is usually needed between feed line and radiating patch as the input impedance may differ from characteristics impedance 50 Ω. But here we are using the CPW-feed Microstrip patch antenna[2] because it have many features such as low radiation loss, less dispersion, easy integrated circuits and simple configuration with single metallic layer, and no via holes required[6]. The CPW fed antennas have some more attractive features such as wider bandwidth, better impedance matching, and easy integration with active devices and monolithic integrated circuits.

Coplanar Waveguide Feed Structure

Feed line is one of the important components of antenna structure given below in Figure-2. Coplanar waveguide [3][4] structure is becoming popular feed line for an antenna. The coplanar waveguide was proposed by C.P. Wen in 1969. A coplanar waveguide structure consists of a median metallic strip of deposited on the surface of a dielectric substrate slab with two narrow slits ground electrodes running adjacent and parallel to the strip on the same surface. This transmission line is uni-planar in construction, which implies that all of the conductors are on the same side of the substrate.

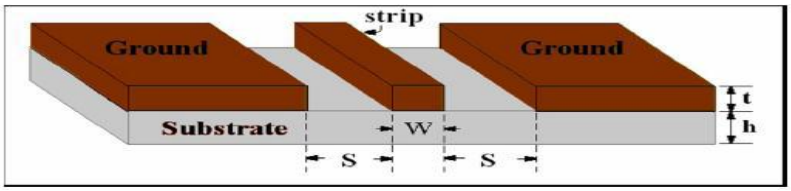

Figure.2 CPW Feed Structure

Etching the slot and the feed line on the same side of the substrate eliminates the alignment problem needed in other wideband feeding techniques such as aperture coupled and proximity feed.

Antenna Design and Structure

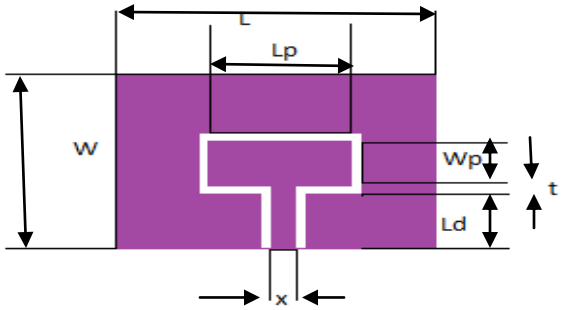

Figure.3 Geometry of CPW-Feed Patch

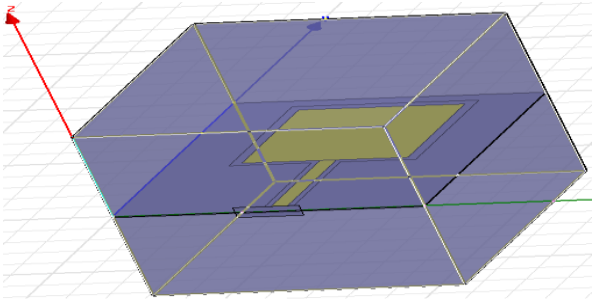

Figure.4 3D Structure of CPW Feed Micro-strip Antenna

The geometry of the proposed antenna is shown in Figure.3 & its 3D design is shown in figure.4. The design of the antenna is started with determination of important parameters which directly influenced the antenna performance. Using rectangular we got bi-directional radiation. The antenna has been designed on Arlon880 substrate with relative dielectric constants of 2.17 with the following dimensions : Length of ground plane(L) = 10 mm, Width of ground plane(W) = 7.5 mm, Length of the patch(Lp)= 4.3 mm ,Width of the patch(Wp) = 1.58 mm , Height of substrate = 0.254 mm, The slot thickness (t) = 0.4mm and the width of the central strip(x) are 0.2mm & Ld = 5.3mm.The patch was designed to achieve the bandwidth of 230MHz &400 MHz respectively at 3.5 GHz frequency. . The width of slot of CPW feed line is 0.254mm to match the impedance characteristic of 50Ω. As seen the measured return loss is -30dB & -28dB at the resonating frequency of 1.79GHz & 2.83GHz respectively.

Results & Discussion

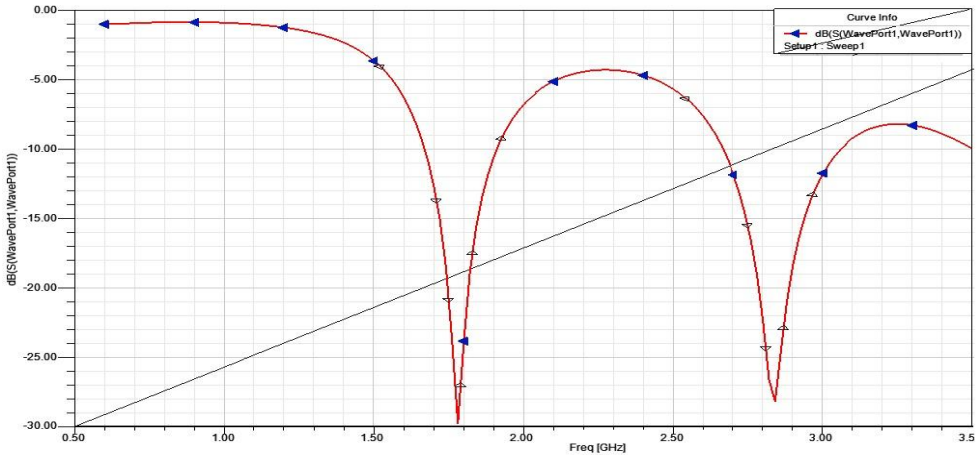

Figure.5 Return loss of CPW feed Microstrip Antenna

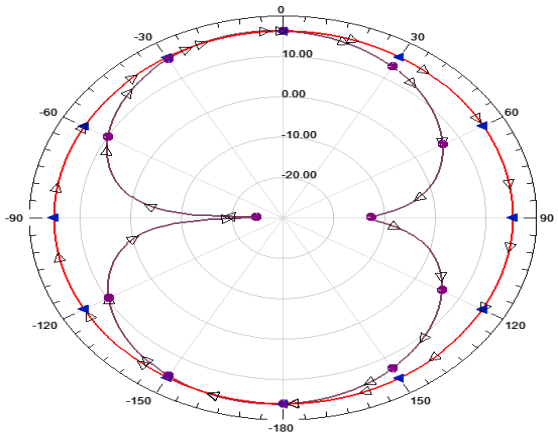

Figure.6 Radiation pattern of microstrip antenna

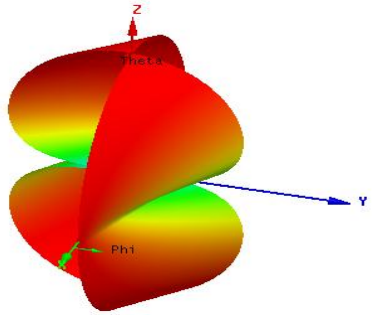

Figure.7 3D Radiation pattern of microstrip antenna

For the proposed antenna design, HFSS simulation software is used, which is full wave electromagnetic simulation software for the microwave and millimeter wave integrated circuits. First, the simulation was started with a CPW-fed rectangle shaped patch antenna. Then we achieved two bandwidth . The simulated return loss,2D & 3D radiation pattern of the CPW Feed Microstrip antenna is shown in Fig.5, Fig.6 and Fig.7 respectively. At resonant frequencies of 1.79 GHz and 2.83 GHz, the antenna had return loss at -30 dB and -28 dB respectively. The simulated impedance bandwidths (10dB return loss) are 230 MHz at 1.79 GHz and 400 MHz at 2.83 GHz, which shows that the antenna has a good impedance matching and feed location at both frequencies. Radiation Pattern shows that the antenna has good power radiation at the frequencies 1.79 GHz and 2.83 GHz.

Conclusion

A new CPW-fed Microstrip Antenna is proposed for the UHF applications. The antenna has small size with good impedance matching. Simulation results shows at L1 and L2, the antenna has return loss at -30dB and -28 dB respectively. And the bandwidth of the antenna is approximately 230MHz & 400MHz ranging from 1.67 GHz to 1.90 GHz and 2.65 GHz to 3.05GHz. The designed antenna can be used for WLAN, Bluetooth , WiMAX & GPS applications.

References

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