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Studies on A-shaped Microstrip Patch Antenna for Wideband Applications

M. R. Tripathy and Dipesh Kapoor

Department of Electronics and Communication Engineering, Amity School of Engineering and Technology, Amity University Uttar Pradesh, Sector 125, Noida, U. P. 201303.

Abstract

The A shaped microstrip patch antenna is designed on a substrate of 30×50 mm^2 with 2 mm thickness. It has shown that the bandwidth of 3.2 GHz ranging from 3.3 GHz to 6.5 GHz with VSWR < 2 and Return Loss (S_{11}) < -10 dB. The ground is divided in 4 parts with 0.5 mm gap between them. The antenna has been successfully simulated. This antenna is designed for the match impedance with 50 ohm of characteristic impedance. FR4 Epoxy substrate material is used with 0.02 as dielectric loss tangent and 4.4 as permittivity.

Keywords: Wide band antenna, Return Loss, Microstrip Patch antenna.

1. Introduction

The microstrip antenna is widely used in various applications because of its large number of design possibilities such as planar, conformal or array and can be fed using many different methods [1 - 4]. It can be compact, reconfigurable and suitable for smart antenna applications. Beam steering and ultra wideband features of microstrip antenna make the applications highly promising and interesting. These are used in applications which requires high-performance, low-cost planar antennas such as imaging array, phased array and collision avoidance radars. The DS-CDMA approach uses three spectral modes of operation, low band (3.1 to 5.15GHz), high band (5.825 to 10.6GHz), and multi-band (low band plus high band). MB-OFDM approach divides its full band 3.1 to 10.6GHz into 14 sub-bands with each bandwidth of 528MHz. Each sub-band consists of 128 tones and is modulated with OFDM. The MB-OFDM approach uses lower three bands (3.1 to 4.8GHz) as a mandatory mode [5-6]. The proposed antenna is designed and suitable for MB-OFDM and DS-CDMA low band.

The design procedure followed is similar to the wideband microstrip transition reported [1] previously, in which energy is coupled electromagnetically from CPW into a microstrip line. The design of this antenna was done by using the commercial electromagnetic simulators (HFSS 13.0). In this paper, antenna design is explained in the section II. Result and discussion is done in section III. The conclusion is made in the section IV.

2. Antenna Design

Antenna is simulated on a substrate of material FR4 epoxy with a permittivity of 4.4, loss tangent of 0.002 and thickness of 0.2 mm.

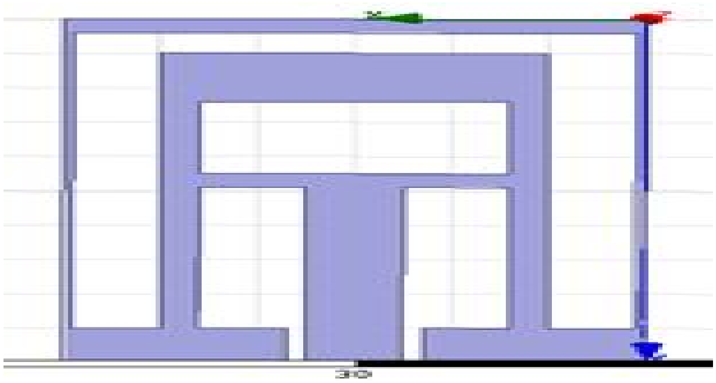

Fig. 1: TOP view of proposed structure.

As shown in the Fig. 1, the size of proposed antenna is 30×50 mm^2 along with a 50 Ω coplanar feed. It consists of an A-shape patch having 40 mm height and 20 mm width with the boundaries merged with the patch along with the feed. This antenna is designed to match impedance with 50 ohms of characteristic impedance of transmission line. The return loss S_{11} is less than -10dB and the VSWR is less than 2 for the frequency range of 3.2 GHz as shown in Fig. 2 and Fig. 3. It is to be mention that the dimension wise the size 30×50 mm^2 is less as compared to the antennas proposed before and substrate height 2 mm is very less. The ground is divided in 4 parts each with a displacement between them, 0.25 mm placed on the lower side of substrate. Fig. 2 shows the return loss (S_{11}) which states that for frequencies 3.3 GHz to 6.5GHz S_{11} < -10 dB. Fig.3 shows the VSWR which states that for frequencies 3.3 GHz to 6.5GHz VSWR < 2. Fig. 4 shows the Far Field Radiation Pattern for phi (Φ) varies from 0° to 90° and theta (θ) varies from -180° to 180°.

3. Result and Discussions

Fig.2 shows that for frequencies from 3.3 GHz to 6.5 GHz the S_{11} < -10 dB. Fig.3 shows the VSWR less than 2 for frequency range from 3.3 GHz to 6.5GHz. Fig. 4 shows the Far Field Radiation Pattern for phi (Φ) varies from 0° and 90° and theta (θ) varies from -180° to 180°.

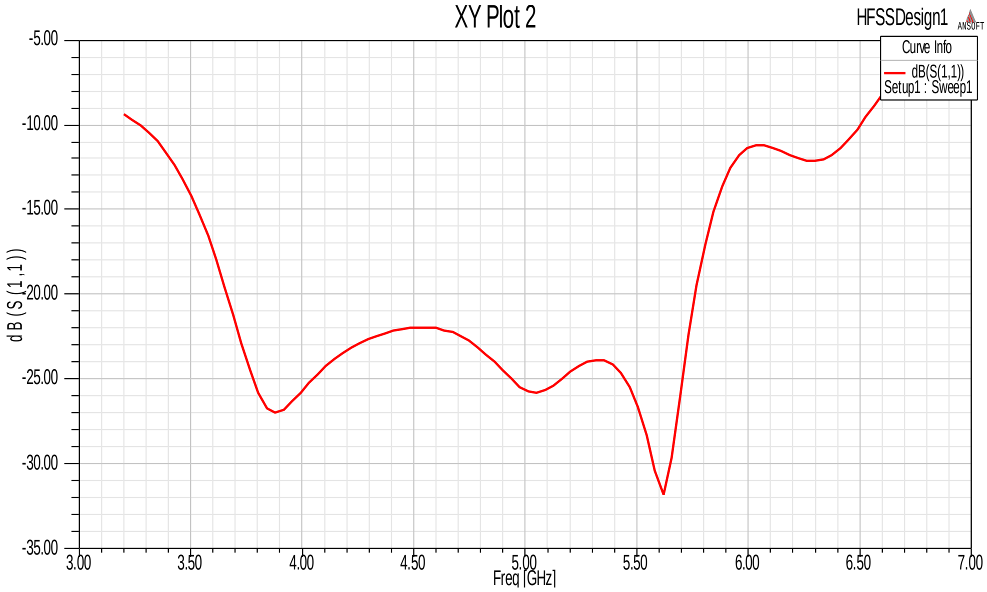

Fig. 2: Return Loss (S_{11}).

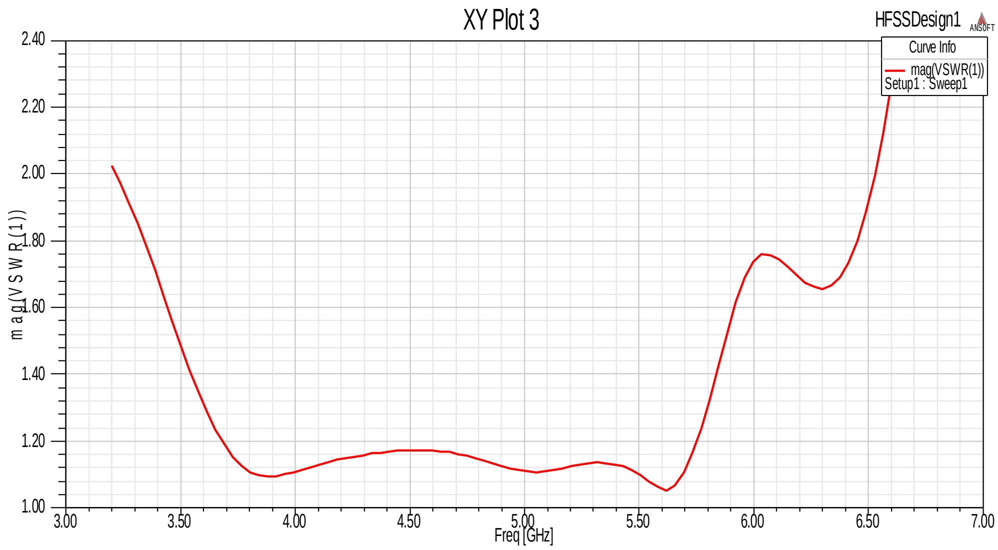

Fig. 3: VSWR.

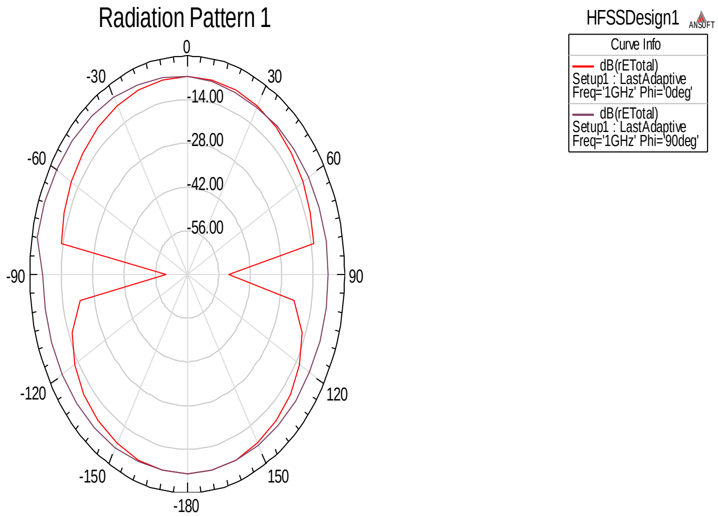

Fig. 4: Radiation Pattern.

4. Conclusion

This paper presented one Wide Band microstrip antenna. This A-shape patch antenna is easy to fabricate and can achieve wideband with the frequency range from 3.3 GHz to 6.5 GHz, which covers the standard of IEEE 802.15a (3.1-10.6 GHz). This can be used for WLAN standard of IEEE 802.11g/j/a/d (4.9-5.091 GHz, 5.15-5.35GHz, 5.7-5.9 GHz), and also suitable for MB-OFDM and DS-CDMA low band.

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