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Effect of the Height of the Substrate on the Bandwidth Enhancement of Microstrip Antenna

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Abstract

The antenna required for wideband communication should be light weight, low-cost, small size. The present scenario researchers are aim to developing novel design of microstrip antenna which would provide a good broadband. The paper presents an idea of the design of bandwidth improvement microstrip antenna offering wideband is presented. The antenna is fed with microstrip line. The technique for the bandwidth improvement is done varying the height of the substrate from 1.0mm to 2.0mm. This design of the antenna in the paper is propose to operate in the frequency range of X-band from 8 to 12 GHz. The prototype planer antenna is exhibiting an overall wideband of bandwidth 2.2 GHz with reflection coefficient of -37 dB. This type of antenna is very useful in many broadband applications in X- band.

Keywords

Microstrip antenna, Bandwidth, Substrates, Reflection Coefficient

Introduction

Microstrip antenna employment is a breakthrough in wireless communication systems. This led to fulfill the varying demands of the current generation of wireless technology. Microstrip antennas are almost universal used because of their many advantages.

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The notable advantages its being light weight and economical efficient [1]. However, narrow operating bandwidth is the prime disadvantage of it. This imposed restriction in wider use in communication systems. Broadband application multitasking, and reliable wireless communication devices have become an essential part of our daily communication life, the need for low profile miniaturized multi- and wideband antennas has escalated [2]. Separate antennas are in use for wireless communication systems operating in the X-band. Hence, it is very much needed of a single wideband antenna operating in multiple frequencies for multitasking, because the demand is the more use of such systems in one setting. Microstrip antenna fulfils most of the requirements for medical equipment, mobile and satellite communications. Numerous commercial requirements are fulfilled by the use of microstrip antenna. The low bandwidth (3% to 6%) of this antenna is insufficient for its usage in many wireless communication systems nowadays. Recently many methods have been reported to increase the antenna bandwidth in X-band [3] and other operating wireless band [4, 5]. The effects of notches are also reported in various literatures [6, 7]. The effect of slot in broadening is also reported [8, 9].

Analysis of Design

The first step in designing of the micro strip antenna is to select operating frequency and appropriate substrate selection. The size of the antenna is the function of resonant frequency; hence this must be suitably selected. The designed antenna must be operated under desired frequency band. to designed the specific antenna in the X band region, the initial frequency is taken at 10 GHz, which is near about the mid of the X band region. The next step in the antenna designing to choose suitable substrate. The height of the substrate and dielectric constant depend on the electrical characteristic of the antenna .smaller height of the antenna will increase the bandwidth but other side spurious coupling will happen. Spurious coupling problem can be reduced by selecting low dielectric substrate. The resonant frequency selected in this paper for presenting the antenna is 10GHz. Duroid material is selected for the substrate selection. Substrate with a high dielectric constant reduces the size of the antenna, because size of antenna is inversely proportional to the dielectric constant. It is also essential that the antenna should not be bulky, therefore the height of the substrate is selected between 1 mm to 2 mm. The feeding method in use for this microstrip antenna is a microstrip feedline. The dimension of the patch of the antenna is calculated using series of equations [10]. The length and width of the antenna, as calculated, come out to be 7.89 mm and 9.11 mm. The final length of the antenna is kept 8 mm better matching. The simulation is done in HFSS.

Result and Discussion

We have taken four set of observation as shown in figure 1.In the first case of observation, the height of substrate is kept at 1mm; the bandwidth obtained is 1.8 GHz(fig 1a) at reflection coefficient of -35 dB. In second set of observation the height of substrate is varied from 1 to 1.5 mm,it gets a bandwidth of 1.85 GHz(fig 1b) on the same reflection coefficient. In third test, the height is taken at 1.8 mm, and the bandwidth is found to be 1.7 GHz(fig 1c) of the same reflection coefficient as earlier two tests. In last set of observation, when height of substrate is taken at 2 mm, it shows a bandwidth

of 1.4 GHz (fig 1d) having reflection coefficient of -35 dB. Thus the antenna design shows a good broad bandwidth when the height is kept at 1.5 mm.

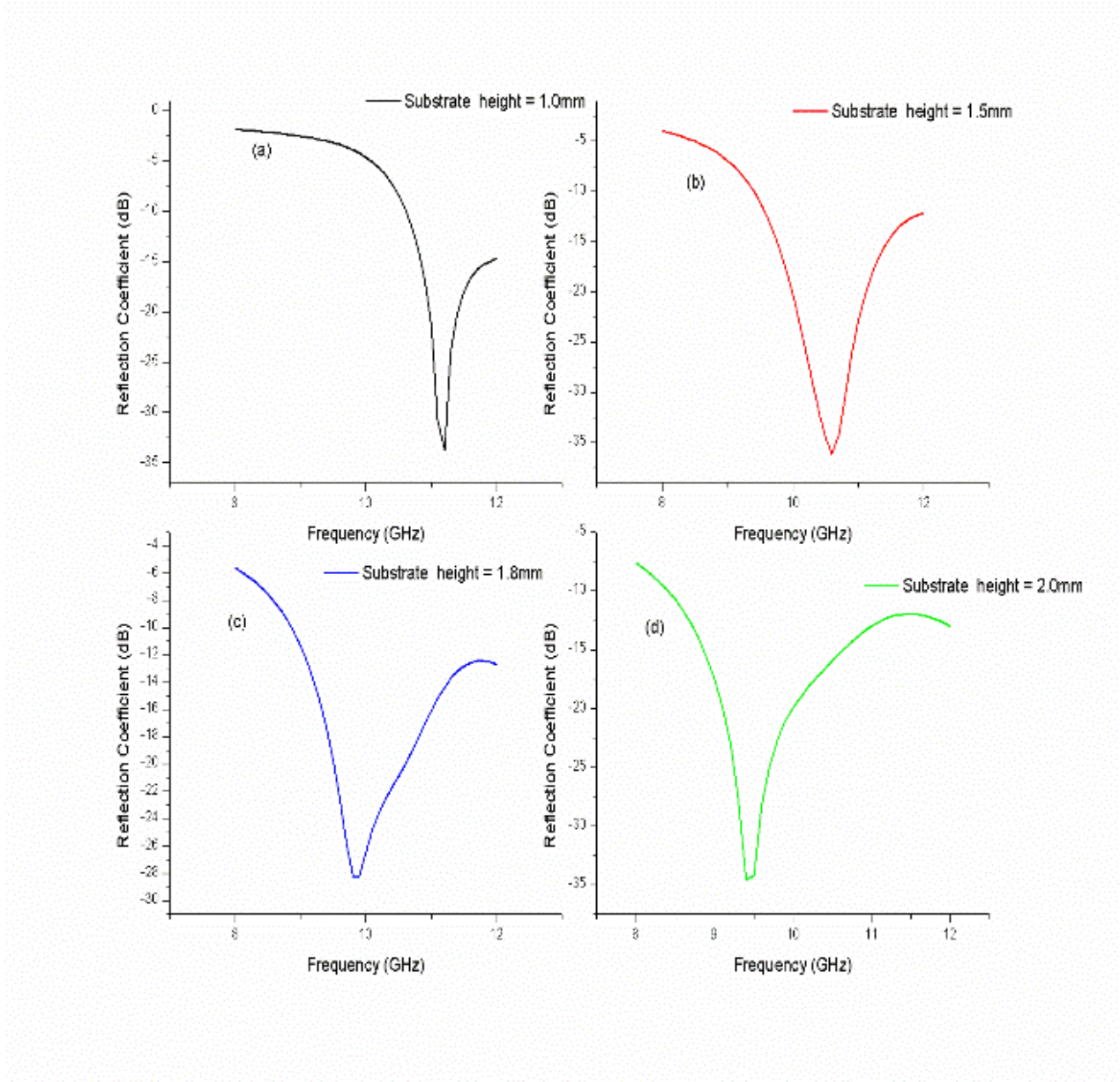

Figure 1: Set of variation in bandwidth with variation in the height of Substrate.

It is shown in the figure 2 that the maximum bandwidth is obtained when the height of substrate is kept at 1.55 mm and also better reflection coefficient of -37dB is obtained. In all these set of observations, we have chosen the length of substrate at 17mm, width of substrate at 23mm.

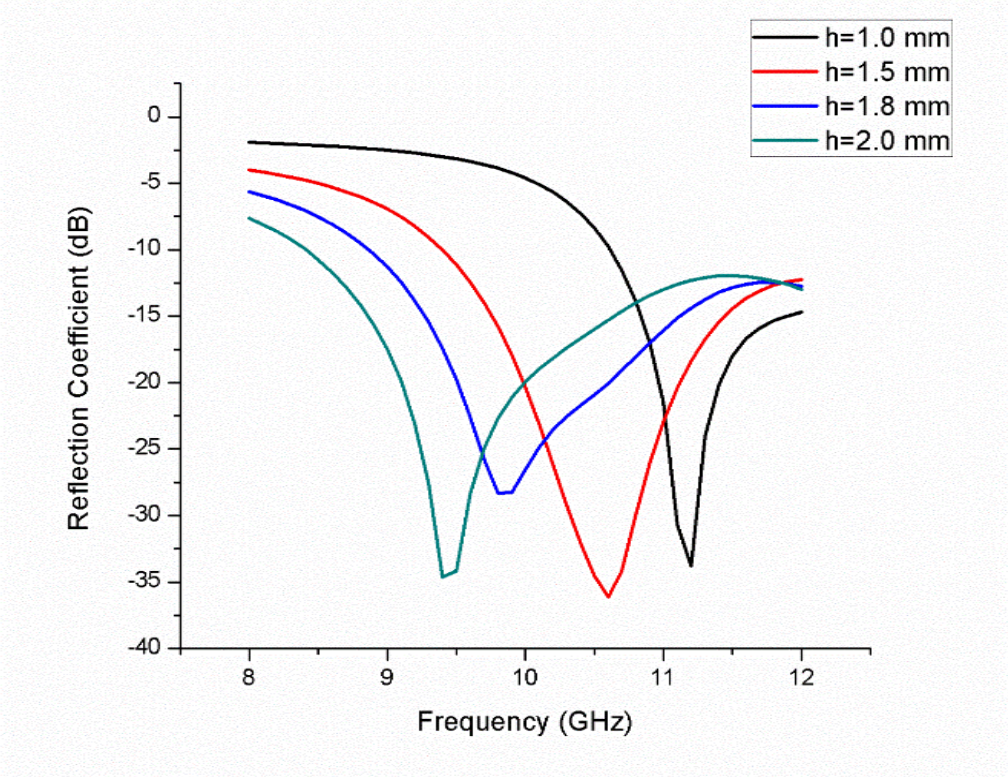

Figure2: Variation of bandwidth with different height of substrate.

A set of the observations recorded in figure 1 and 2 provide the final compact dimension of the microstrip antennas23 mm by 17 mm with a height of 1.5 mm. The size of the patch of the antenna is 8 mm by 15.5 mm feed with a rectangular microstrip line of dimension 7 mm by 2.25 mm.

Conclusion

The design of the rectangular microstrip antenna is presented. The broadband is obtained by the adjustment in the height of substrate keeping all other dimension same. The antenna design is single layer, compact and very simple. The antenna has shown a good bandwidth of 2.2 GHz for substrate height of 1.5mm, which is considerable for good wide band wireless application.

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