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Design of Multiband Microstrip Patch Antenna Using Proximity Coupled Technique

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Abstract – Author have studied various design techniques to design multiband patch antenna. Proximity coupled technique was found more suitable and efficient to design a multiband antenna. This proposed designed antenna is able to operate in two distinguished frequency that means proposed antenna is a dual band antenna with large bandwidth and high directivity. This proposed design contains a defected ground, a rectangular patch and a meandered feed, which is designed to connect a SMA connector. Designed antenna is a 3 layer device having higher radiation intensity at 1.96 and 2.6GHz.

Keywords – proximity coupled, meandered feed, return loss, microstrip.

1. INTRODUCTION

Despite of its several advantages, like having small size, low cost and low operating power, it also has many disadvantages too, like low gain, narrow bandwidths and limited capabilities of operations. The requirement of multiband antennas with high bandwidth is growing tremendously in last two decades and is still in much demand. To fulfill the requirement various studies were presented to overcome the disadvantages and improve the positive points on much higher grounds presented in [2], [3], and [4]. The wideband is achieved by using proximity coupling technique where no contact has been made by the feed line and the patch. Apart from this proximity coupling if a slot is also introduced in the ground of the patch then tremendous results can be seen. This paper uses a third technique too along with these too, author proposed a meandered feed along with proximity technique so that the results may improve a little bit [5], [9].

The proximity feeding technique is simpler and more commonly used technique to realize broadband microstrip antennas for substrate thickness greater than $0.06\lambda_0$ [16]. In proximity fed configuration the coupling strip is either placed below the patch or it is placed inside the slot which is cut on the patch. However, design guidelines for the coupling strip parameters are not available.

One basic technique for designing multiband MPAs involves the use of multilayered structuring [11] in which a series of microstrip patches operating at multiple frequency ranges are vertically stacked onto a ground plane, increasing the height of the MPA. A further refinement of the multiband microstrip antenna concept involves adding a stub, which increases the antenna size, and a slot, which produces the radiation pattern of the harmonics. Some inserted grooves into the design of an annular ring patch antenna to attain multiband operation. However, their antenna design did not cover the required bandwidths with the result that the polarization of the antenna had to be varied by the resonant frequencies.

2. ANTENNA DESIGN & SIMULATION RESULTS

In this design process a three layer antenna was designed, a defected ground plane, a meandered proximity feed and a rectangular patch. The defected ground structure contains three parallel diagonal cuts, and the meandered feed is also a combination of parallel cuts and the patch contains a large width rectangular patch. Following are the designed configuration of the antenna.

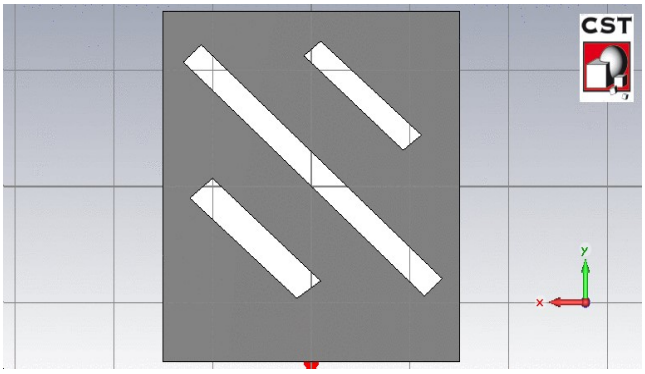
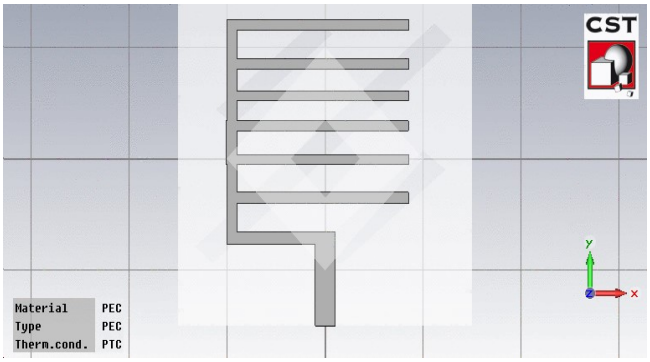


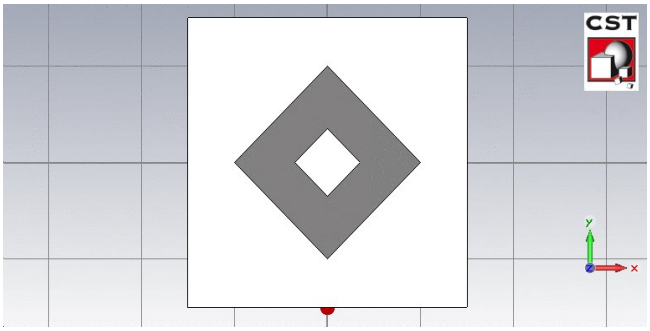
Figure.1 Defected base structure

The designed antenna base structure is depicted in Fig. 1, this structure is showing parallel lines of same width. A 45 degree inclined rectangular patch with a rectangular slot at its center is printed on top of the upper layer. The bottom side metal of this layer is fully etched out. Proximity coupling is obtained by a meandered microstrip feedline

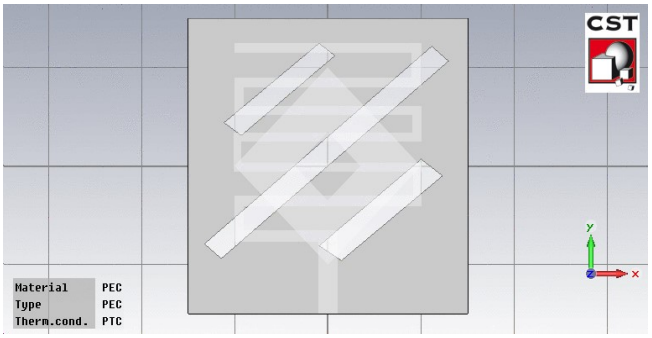
printed on top of the lower substrate layer. The slotted ground structure is on the lower side of this substrate. In order to keep a provision for connection of inner conductor of a SMA connector to the microstrip feed it is connected between two substrates to make proximity coupled feed. Commercial software CST-MWS is used to perform the simulations. In this proposed antenna, slots are etched in the ground plane of the lower layer to create multiple resonators having different resonance frequencies. The slot resonator radiates at their corresponding resonance frequencies.
Above layers of proposed design are shown in following figures.



(a)



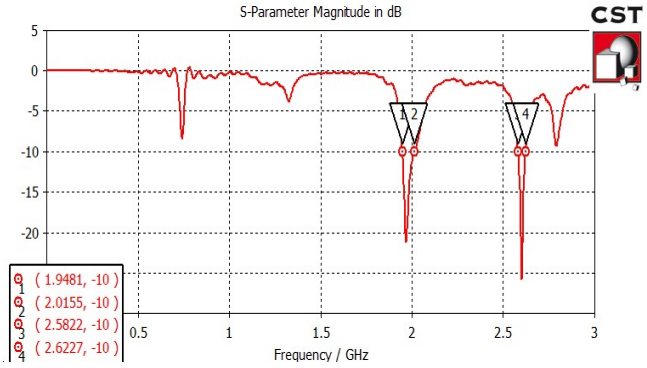
(b)



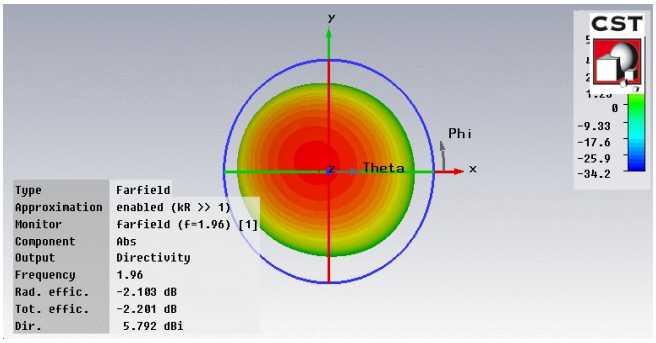
(c)

Fig. 2. Configuration of the proposed antenna: (a) 3D Design of meandered feed above lower layer, (b) geometry of upper patch, (c) Shows all the designed layer on each other

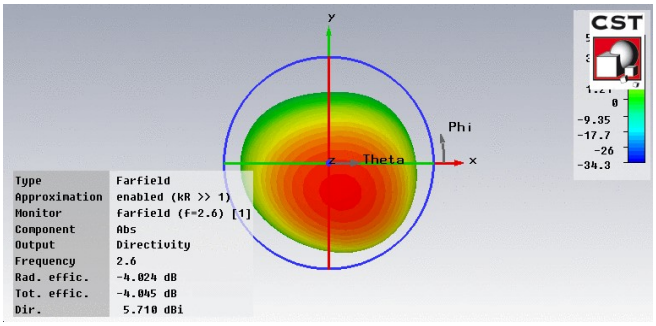
The radius of the inclined patch on the top surface is 14mm and diagonal length of the defected ground is 44mm for the central cut and the surroundings have the length of 21mm and width is 3mm.
Following figures shows the result of the proposed patch.



(a)



(b)



(c)

Fig. 3. Simulated result of the proposed antenna: (a) showing return loss of the proposed design, (b) radiation pattern showing on operating frequency1.96GHz, (c) Radiation pattern and directivity at frequency 2.6GHz

After the simulation it has been found that the desired results have been achieved. In literature survey of multiband antennas it already investigated that proximity coupled feeding technique is a good approach to design a multiband

antenna. A design process has been followed and the desired multiband frequencies have been achieved with a large bandwidth. The return losses for the dual frequencies of 1.96 and 2.6 GHz are -22 and -26dB respectively. Along with the return loss, bandwidths for both the operating frequencies are 67 and 44MHz respectively. Directivity is also satisfactory, for 1.96GHz it is 5.79dBi and for 2.6GHz it is 5.71dBi.

3. CONCLUSION

Proposed design is fulfilling the requirement of a multiband antenna. The proposed design is a 3 layered device which contains the stacking of proximity feed among the ground plane and patch. This proposed design is operating on two distinguished frequency of 1.96 and 2.6 GHz which are suitable for the operation of L band and S band simultaneously. Return loss of both the operating frequencies are -22 and -26dB respectively which is sufficient enough for the LAN applications. Further improvement in this field can increase the bandwidth and directivity as well.

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