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Microstrip Patch Antenna For Wireless Communication

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ABSTRACT

A small size low profile microstrip patch antenna with different shape configuration like L, U and E- shape is presented here. Slot insertion causes size reduction which increases the bandwidth and return loss. So here we will see the performance of bandwidth enhancement and return loss by graphical analysis of different value. This paper reviews the performance analysis of compact and small planar monopole antenna with symmetrical L and U- shaped slots for wireless local area network (WLAN) and worldwide Interoperability for microwave access (WiMAX) (2014). Circularly polarized arrowhead shaped slotted microstrip antenna (2014), small UWB Planar Monopole Antenna with Added GPS/GSM/WLAN Bands (2012). Application of characteristic mode to commonly used circular polarized U-slot and E-shaped patch antenna (2012). Bandwidth enhancement of a polarization reconfigurable antenna with stair slots on the ground (2014). This paper also discusses the technology incorporated in order to bring about the required change in terms of improved performance. The performances of the antenna are compared along with measured and simulated result.

Introduction

A compact microstrip patch antennas became very useful primarily for space craft and aircraft application. Today they are used for government and commercial applications like GPS service for land vehicles, maritime vessels to find there correct position, reason for the same being it's advantage light weight, low profile, simple and inexpensive, conformal to planner and non planar surface to fabricate using modern printed circuit technology, mechanically stable when mounted on solid surfaced, compatible with MMIC designs. In this paper we have reviewed some papers about microstrip patch antenna and will see the performance of parameter on the basis of comparative analysis of bandwidth enhancement and return loss value of different papers.

Literature survey

Author Mahdi et al. [1] has presented small and low profile microstrip fed monopole antenna for triple and operation that satisfy the WLAN (2.45.2/5.8 GHz) & WiMAX (2.5 /3.5/5.5GHz) frequency. Low profile multiband antenna are relative large size and not provide desired bandwidth, So for improving bandwidth and size reduction is to use monopole antenna with slot inserted. Table.1 Shows the size reduction of patch can improve bandwidth and return loss.

L and U shape slot design

In above table we seeing slowely and gradually as dimensions of the patch reduce we achieve the WLAN and WiMAX frequency of the proposed antenna. In this letter proposed antenna is consist of rectangular radiating patch with a pair of symmetrical L & U- shaped slot is inserted, amicrostripstrip feed line is used and ground plane as shown in Fig.1.

First step of configuration of the proposed antenna is simple as shown in fig 2.(a). with dimensions (L_{sub} × W_{sub} × t_{sub}) is 15×15×1.6 mm^3. A 2mm microstrip feedline is connected to a rectangular patch of an antenna. The substrate of proposed atenna is FR4 with permitivity 4.4, loss tangent of 0.024 and thickness t_{sub} of 1.6mm In fig.3. the performance of return loss value of antenna 1 is a wide range of frequency band is obtained between 2-3 GHz that does not satisfy the required frequency of WLAN and WiMAX at particular frequency.

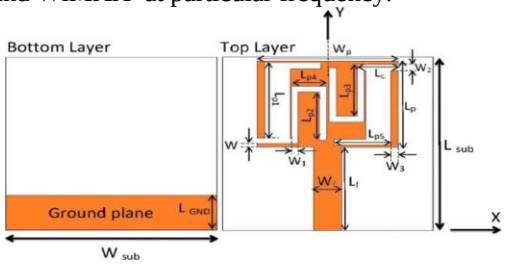

Fig 1. configuration of proposed antenna

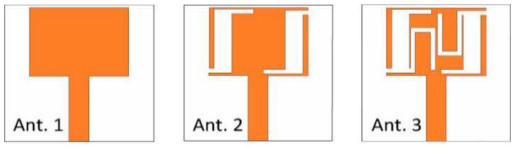

Fig 2. Configuration of antennas with (a) 1 an ordinary patch (Ant. 1), (b) a pair of symmetrical L-shaped slots on the patch (Ant. 2), and (c) a pair of symmetrical L- and U-shaped slots (Ant. 3)

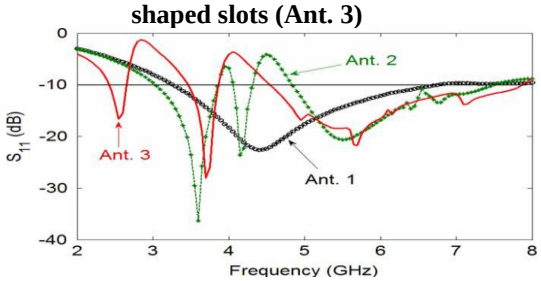

Fig 3. Return loss value for Ant.1, Ant.2, Ant.3, Arrowhead slot design

Now in second step here is insertion of symmetrical L – shaped slot at the end of patch, so the effect of slot on the reflection coefficient is the three resonant band frequency is obtained that also does not cover the desired frequency band i.e.

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2.4GHz band for WLAN 2.5/3.5GHz band for WiMAX. Finally in last step we obtained the desired frequency band by inserting a pair of U – shaped slot with already inserted symmetrical L-shaped slot. Further Author Anil Kr. Et al. [2] has reported bandwidth and return loss value by inserting a slot of arrowhead shaped into patch with single feed.

Slot is embedded in the first quadrant of diagonal axes of the square patch to achieve good CP (circular radiation) as shown in fig. 4.

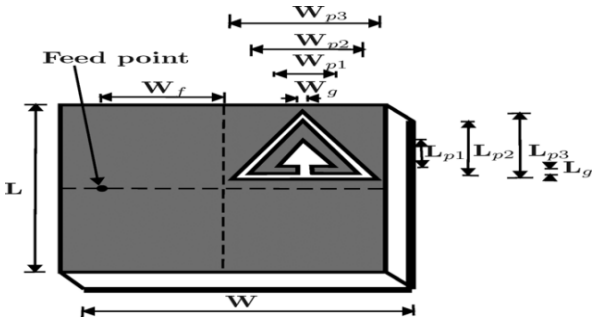


Fig4.Schematic diagram of arrowhead shaped antenna

Now we will see the return loss value against frequency with triangular slot, concentric slot and arrowhead slot on graph and compare this result with above calculated values.

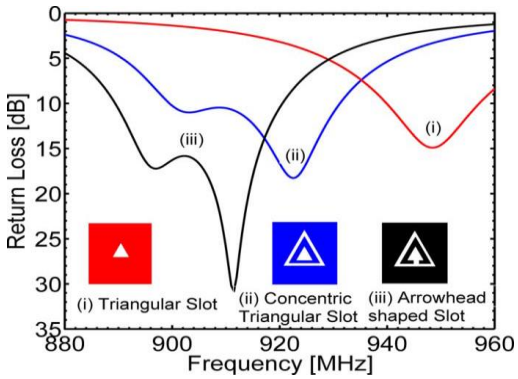


Fig 5. .Simulated returns loss against frequency

Ali Foudazi et al. [3] has further presented diamond shape patch (DSP) with inserting notch region in the middle part of the region that cover the very high frequency i.e. ultra high frequency (UHF) as shown in fig .6.

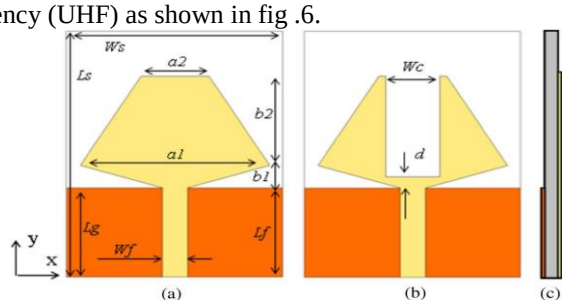


Fig 6. (a) DSP UWB antenna, (b) DSP antenna with inserting notched region in the middle part, (c) side view of the proposed base antenna.

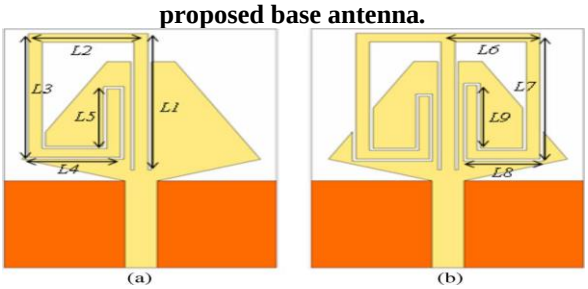


Fig 7. Multi-band DSP antenna configurations for (a) dual-band, (b) triple band applications

For achieving multi-band antenna design adding, quarter strip with notch region that is inserted in the middle part of the DSP antenna as shown in fig.7. For multiband antenna center feed methodology is used to design dual and triple band. To obtained multiband behavior additional resonance strip can be inserted in the notch region.

Author Yikai Chen et al. [4] has introduce characteristic analysis of two circular polarized microstrip patch antennas namely U- slot & E – shaped compact size of patch and feed position examine by two modal significance and characteristic angle given by underlying physics based on characteristic mode analysis. The MS represent the contribution of particular mode to the total radiation when a source is applied and characteristic angle physically characterizes the phase angle between a characteristic current and the associated characteristic field. It is clear from the graph that it provide better axial ratio cross polarization performance and does not include any additional design or complexity. CP U-slot & E-shaped patch as shown in fig. 8 and 9. Performance of the axial ratio with return loss against frequency is shown in fig. 10.

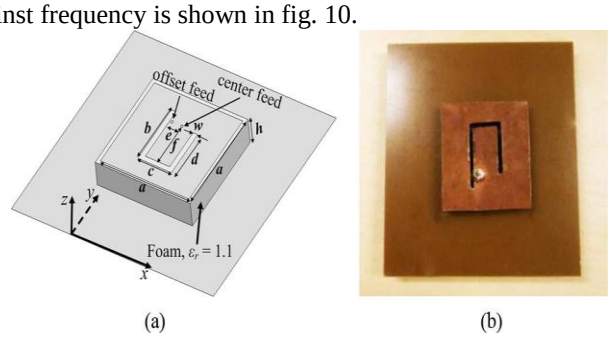


Fig.8. Circularly polarized U-slot antenna with offset feed: (a) the geometry; (b) the prototype. Dimensions

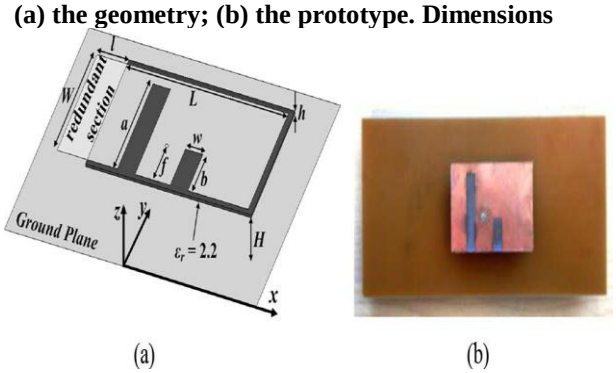


Fig.9. Circularly polarized E-shaped patch antenna with reduced size: (a) the geometry; (b) the prototype. Dimensions

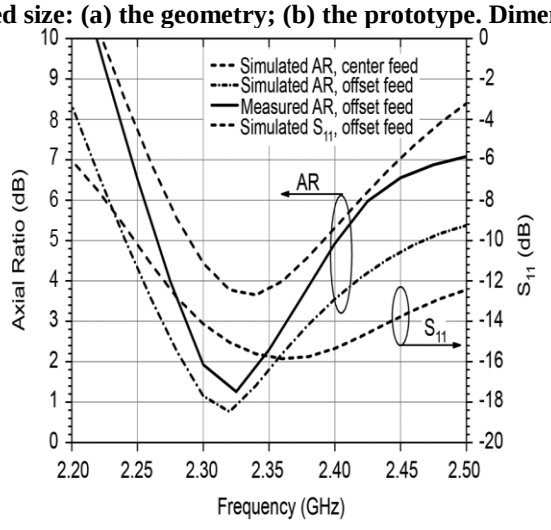


Fig 10. Performances of the U-slot antenna with offset feed: (a) axial ratio

Table. I Dimensions of multiband patch

Ref.	Dimensions (mm^3)	WLAN (2.4/5.2/5.8)	WiMAX (2.5/3.5/5/5)
[1]	$30\times25\times1.6mm^3$	(2.4/5.2/5.8)	-
[2]	$23\times36.5\times0.8mm^3$	(2.4/5.8)	(2.5/3.5)
[3]	$50\times30\times1.6mm^3$	(2.4/5.2/5.8)	-
[4]	$25\times30\times1.6mm^3$	-	(2.5/3.5/5.5)
[5]	$18\times34.5\times1mm^3$	(2.4/5.2)	(2.5/3.5)
Proposed antenna	$15\times15\times1.6mm^3$	(2.4/5.2/5.8)	(2.5/3.5/5.5)

Table. II Literature Review

Antenna Parameter	[1]	[2]	[3]	[4]	[5]
Year	2014	2014	2012	2012	2014
Author	Mahdi et al.	Anil Kr et al.	Ali Foudazi et al.	Yikai Chen et al.	Zi-Xian et al.
Dielectric Substrate	FR4	R04003C	FR4	FR4	FR4
Software	Ansoft HFSS	Ansoft HFSS	Ansoft HFSS & CST	Ansoft HFSS	Ansoft HFSS
Return Loss	-37dB	-31dB	-	-34dB	-32dB
Axial Ratio	0.4dB	0.4dB	-	1.2dB	0dB
Bandwidth	21.6%	-	-	17.9%	7.3%

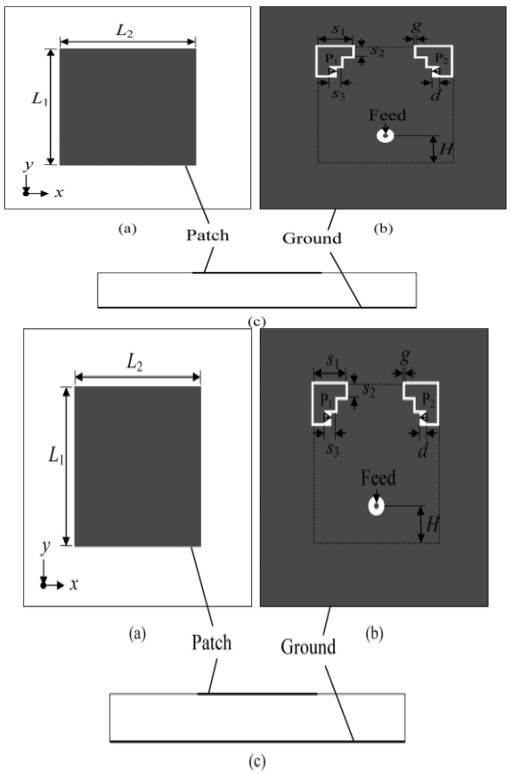
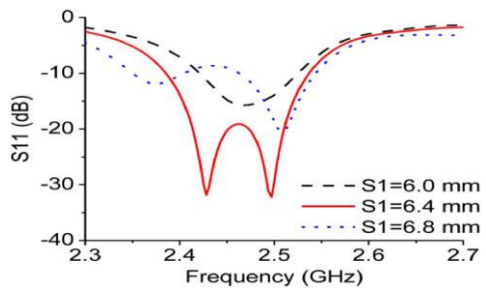
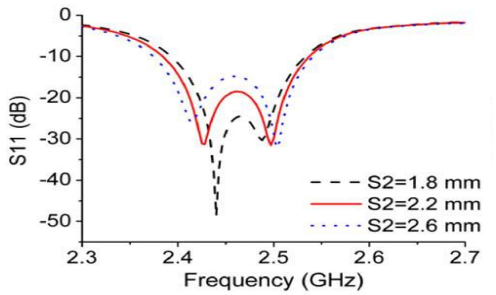


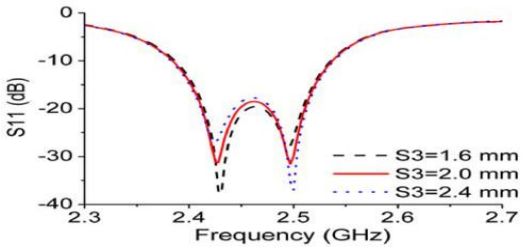
Fig 11. Geometry of the proposed polarization-reconfigurable antenna. (a) Top view. (b) Bottom view. (c) Side view.



(a) effect of s1



(b) Effect of s2 of Fig. 11



(c) Effect of s3 of Fig.11

Fig 12. Effects of slot parameters on the antenna performance

The effect of different parameter on the reflection coefficient s11 is shown in fig.11. Compared to the reference antennas, the stair-slot design enhance the antenna's impedance and AR bandwidth both gradually, and it would be suitable for the wireless communication systems.

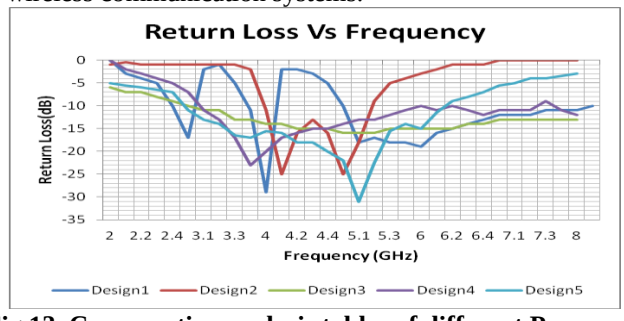


Fig 13. Comparative analysis tables of different Papers on different parameter

Conclusion

In this paper the performance of the microstrip patch antenna is reviewed on the basis of its characteristic parameters like Bandwidth and Return loss. In [1] L and U- shaped slots were implemented, which shows the return loss value as -37dB. Arrowhead shaped microstrip antenna was introduced in [2] and return loss value is seen to be -31dB. A diamond shaped microstrip patch antenna with narrow slits in [3] was introduced, shows multiple characteristics of the antenna. U and E shaped slots were introduced, shows the return loss characteristics as -34dB in [4]. Another rectangular patch antenna with the stair slots on the ground was proposed in [5], which shows the improved polarization and return loss value as -32dB. The review shows that insertion of slots of different shapes on the antenna enhances the different antenna parameters such as return loss, bandwidth and polarization. Also helps in size reduction. Slot implementation technique can also be used to explore filter characteristics to the antenna.

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