

Dual Band Pentagon shaped Patch antenna for UWB Applications



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Abstract: A small-size micro strip-fed dual-band planar antenna is presented. The base of the proposed antenna is a Pentagon Shaped Patch (PSP) that covers the Ultra Wide Band (UWB) frequency range. To create dual band antenna lot of slots are made, thereby to reduce the area of the antenna. This will not affect the dimension of the base antenna. The designed dual band pentagon shaped antenna has the size of 16 x 22 x 1 mm² and covers the UWB frequency ranges. Dual band PSP antenna is simulated and good results are obtained. The antennas have Omni directional and stable radiation patterns across all the relevant bands. The applications of Dual band in the range of 4-8GHz are civil, military, weather monitoring, air traffic control, and in mobile applications as the phones ability to work with two different bands. It is important to specify which bands exactly the dual band pentagon shaped patch antenna is designed by using HFSS Software.

Keywords: Pentagon Shaped Patch (PSP), Ultra wide Band (UWB),

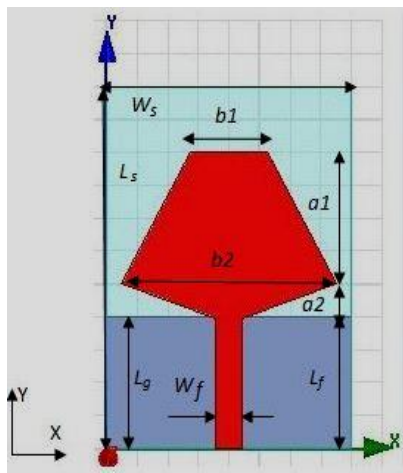
1 Introduction: Ultra Wide Band as the name implies, is a form of technology that occupies a very large or wide bandwidth. Wide Band width they will cross the boundaries of many of the currently licensed carrier based transmission. Ultra Wide Band (UWB) provides an interesting new technology for short range Ultra-high speed communication in the frequency band 3.1GHz to 10.6GHz. It supports a bit rate greater than 100 Mbps within a 10-meter radius for wireless personal area communications.

The advantages of UWB include low-power transmission, robustness for multi-path fading and power dissipation. Modern communication systems require a single antenna to cover several allocated wireless frequency bands. Moreover, design of a multi-band antenna which also covers the UWB range without deteriorating the UWB performance is of high

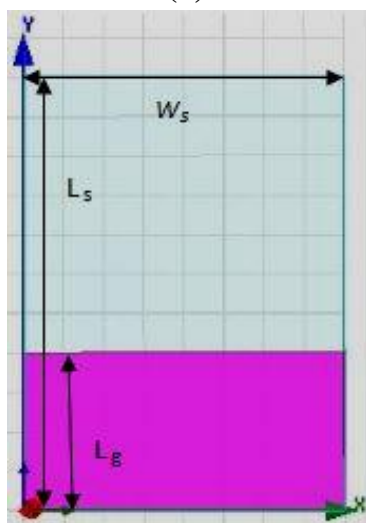
interest. First, a rectangular Patch is designed for that the current is not distributed uniformly. So, in order to make it uniform the rectangular shape is made with pentagon shape. For PSP antenna only single band is obtained. To get the dual band, some slots are inserted on the pentagon shaped patch.

The pentagon shaped patch antenna is considered to cover the frequency range of 4 – 8 GHz. By creating the circles, U – shaped slots and square slots on the patch two frequencies got the best reflection coefficient, which means that it is having low attenuation. The simulation results are carried out through the HFSS software.

2 Design:



(a)



(b)

| | | | | |
|-------------------|-----------------|-----------------|------------------|----------------|
| $a_1 =$ 8mm | $a_2 =$ 2mm | $b_1 =$ 5mm | $b_2 =$ 14mm | $L_g =$ 8mm |
| $W_f =$ 1.86mm | $L_f =$ 8 mm | $W_s =$ 16mm | $L_s =$ 22 mm | ----- --- |

(c)

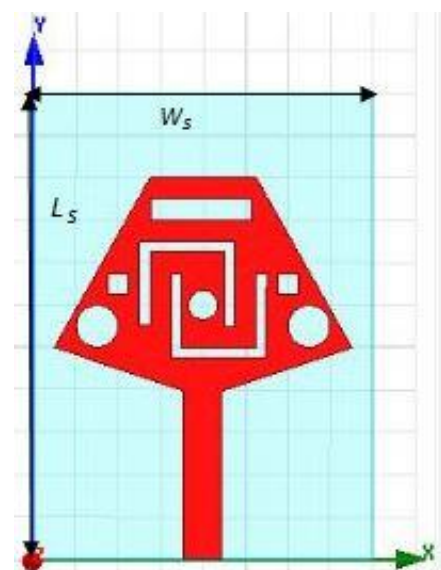
Fig.1. (a)

The front view of the Pentagon shaped patch (PSP) antenna. (b) The back view of the pentagon shaped patch (PSP). (c) . The values of the parameters of the pentagon shaped patch antenna (PSP).

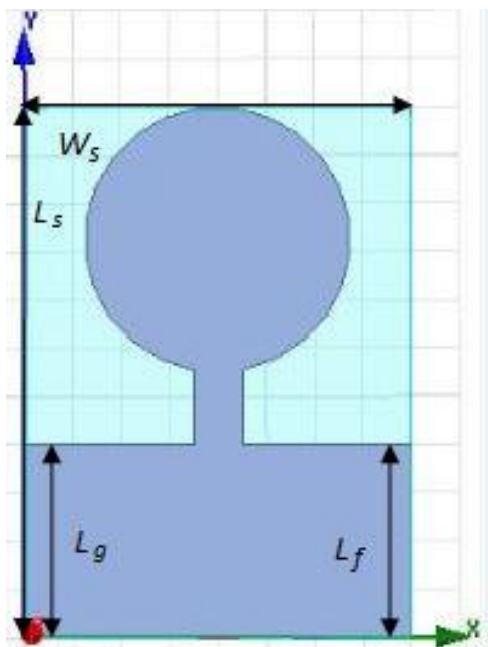
First the Patch and ground are designed in rectangular shape [1], having the width of W_s and length of L_g to the ground and width of b_2 and length of $L_p = (a_1+a_2)$ to the patch and it is simulated. The results that are obtained are poor. So to obtain the better results, changes are made to that rectangular patch. The rectangular patch

is made as pentagon shaped patch [4]. We expected, this outline may give preferable outcomes over past outcomes in reflection coefficient results. After making the changes the design is shown in the fig. 1. The fig. 1. (a). Demonstrates the front view of the pentagon shaped patch design. The fig. 1. (b) Shows the back view of the antenna which is having a width of (W_s) and length (L_g). The antenna is fed by 50Ω micro strip line and etched on FR4 dielectric substrate with dielectric constant $\epsilon_r = 4.4$, loss tangent 0.02, and height $h=1$ mm. There are four parameters a_1 , b_1 , a_2 , and b_2 they could affect the PSP antenna [7]. The PSP antenna did not give the better results, so rectangular section is created along the pivot of PSP antenna to obtain the better results. The reflection coefficient of the PSP Antenna results are poor even after creating the rectangular section. So the rectangular section is removed without affecting the overall antenna impedance and radiation characteristics of the PSP antenna [8]. For a constant value of a_2 , changing the values of a_1 are also gives the poor performance. An appropriate value of b_2 can improve the reflection coefficient at higher frequencies and provide wider impedance matching over UWB range [7]. The narrow notched region has no effect on the reflection coefficient results; also increasing W_c has no effect on cut-off frequency of the base patch [7].

3 Multi-band Antenna Design



(a)



(b)

Figure 2: (a) Front view of the Dual band pentagon shaped patch (PSP) antenna. (b) Back view of the Dual band Pentagon shaped patch antenna. The fig. 2.(a) Shows the front view of the PSP Multi band antenna is having square, rectangle, circle and U shaped slots. The fig. 2 (b) Shows the back view of the PSP multi band antenna is only ground which is having the width of W_s and length of L_g , top of that with a circle and they are united with a rectangle rod. First the PSP antenna is fed by 50Ω , the current is distributed over the patch. But the current is not distributed all over the patch. So the rectangular section is created on the patch near to the b1, that is demonstrated in the fig. 2.(a). Only single band is obtained and it is also not expected results. The current distribution over this PSP antenna mostly concentrated over the outside edges of the patch with negligible current in the center region [9]. So again made changes to the patch to obtain the better results. Now U shaped slots are inserted on to the patch [2]. Then also a single band is obtained but these outcomes are better than the previous outcomes that are obtained in reflection coefficient results. To obtain the multi band, squares are inserted on to the patch, and then obtained the multi band, but reflection coefficient results are poor to this design. So added the circles to this design, and then obtained the multiband results better than the previous outcomes that are

obtained in reflection coefficient results that is demonstrated in the fig. 3. The multiband frequencies are obtained at 5.1GHz and 6.5GHz. That is demonstrated in the figure. 3. The VSWR is measured at the frequencies of 5.1GHz and 6.5GHz. The VSWR results are obtained below to the 2 dB range, 1.3429 at 5.1GHz and 1.2704 at 6.5GHz that is demonstrated in the figure. 4.

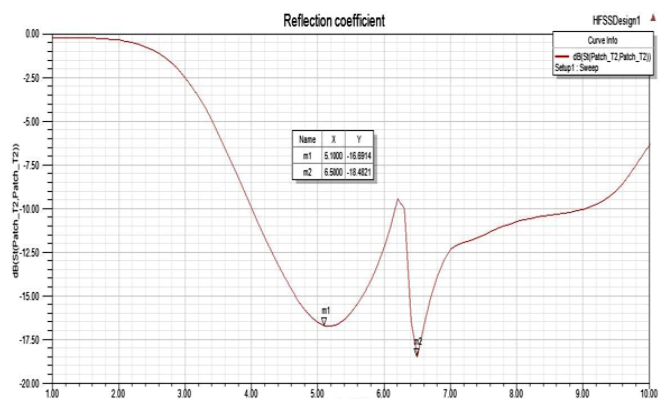


Figure 3: The reflection coefficient of the Dual band pentagon shaped patch antenna.

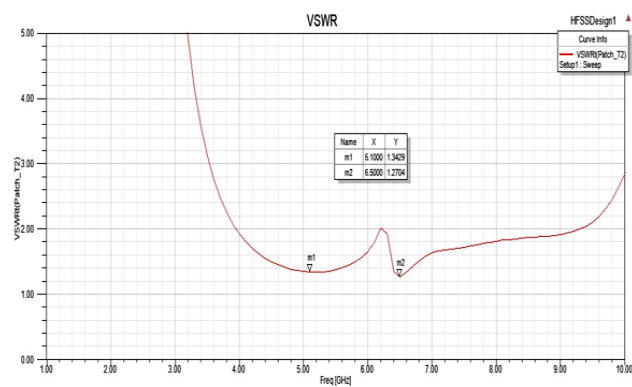


Figure 4: The VSWR results of the Dual band pentagon shaped patch antenna.

4. Conclusion: The pentagon shaped patch antenna is implemented by the U shaped, rectangle, circle, and square slots to cover the UWB ranges. The PSP antenna is supports at 5.1 and 6.5 GHz in UWB frequency ranges. These frequencies are used for applications such as Satellite and Microwave. The slots are helps to get the multiband range. The multi band antenna had gain similar to the UWB.

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