Bandwidth of Planar Antennas for UWB (6GHz - 8,5GHz)

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ABSTRACT

The purpose is to design the different antennas and understand how they work, the differences among them and the techniques to create them with specific software. The goal is to modify them in order to have the best antennas as possible and decide which the best one for the studied range is .the planar antennas choose of this study because of their advantages with Ultra Wide band .in this design using Advanced Design System (ADS) because it one of the best software of telecommunication application and it can give a chance of define specification of antenna with their materials type of antenna.In this paper design of five kinds of antennas is made: reference dipole antenna, basic square antenna, square antenna with bevel, square antenna with offset, square antenna with pin and disc antenna, which work on the UWB band, the exact range these work on is from 6GHz to 8,5GHz.
KEYWORD:-Ultra Wide Band (UWB), Voltage standing wave ratio (VSWR), Bandwidth (BW), Advanced Design System (ADS)

1.INTRODUCTION

In this paper general parameters for the antennas is study, such as theoretical gain, radiation pattern, polarization and frequency limits. But there is an important parameter which we are not going to study, it is the bandwidth. The reason it doesn't study it is because there are several manners of defining it. Will treat it as impedance bandwidth, but in this case it can define several values for the bandwidth, depending on the VSWR are working with. This part is defined in the simulation part. After considering the characteristics we will write some interesting comments in each section. All the antennas are considering are linear antennas, never use circular antennas. These kinds of antennas focus the radio energy from the reader in a narrow beam. This increases the read distance possible and provides greater penetration through dense materials. Tags designed to be used with a linear polarized reader antenna must be aligned with the reader antenna in order to be read. While the other ones are used in situations where the orientation of the tag to the reader cannot be controlled. Since the waves are moving in a circular pattern, they have a betterchance of hitting the antenna, but circular-polarized antennas have a shorter readrange thanlinear-polarized antennas. It means are supposing to work with Line Of Sight systems. The advantages of these kind of antennas is that they are more robust to interferences and they are very good in penetrating surfaces. Apart from this, the polarization can also be horizontal or vertical. Depending on how are transmitting or receiving the signals, left to right (horizontal) or up to down (vertical).

2.METHODOLOGY

The design have based in ADS is an electronic design automation software system produced by Agilent. It provides an integrated design environment to designers of RF electronic products such as mobile phones, wireless networks, satellite communications, and radar systems. ADS supports every step of the design process --schematic capture, layout, frequency-domain and time-domain circuit simulation, and electromagnetic field simulation. It allows the engineer to design and an RF design without changing the software. In our case, antenna design, we can easily create the antenna by drawing a layout. After that, we can simulate it and showing the different measures we are interested on, like VSWR, gain/directivity, input impedance or radiationpattern.

2.1SPECIFICATION
The specifications for the design are:
- Frequency band: 6GHz-8,5GHz.
- Substrate Flexible: RO4350B
- Substrate height: 0,22mm
- Conductor thickness: 0,254mm
- Relative permittivity: 3,25

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2.2 CALCULATIONS

To know how long the antenna is to have our starting point in the design. It means need to get the value of λ, which is the wave length, this value this value will be used to calculate the length of the antennas, which is λ/4.
The operations made to obtain it are the followings:

$$BW = 8,5 - 6 = 2,5 GHz$$

$$f_c = \frac{f_L + f_u}{2} = \frac{6 + 8,5}{2} = 7,25 GHz$$

Where f_c is the central frequency, f_L is the upper

$$\lambda = \frac{v_p}{\sqrt{\varepsilon_r} \cdot f_C} = \frac{3 \cdot 10^8}{\sqrt{3,25} \cdot 7,25 \cdot 10^9} = 0,022\, m$$

frequency in the range and f_u is the lower frequency. Where λ is the wave length, v_p is the propagation velocity and ε_r is the relative permittivity

$$\frac{\lambda}{4} = \frac{0,022}{4} = 5,5 mm$$

2.3 DESIGN PROCESS

In Fig 1 the different antennas we have to design in ADS software are shown, the length of each of them is indicated, too.
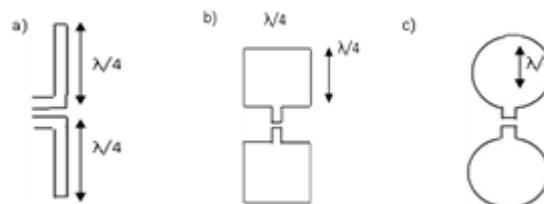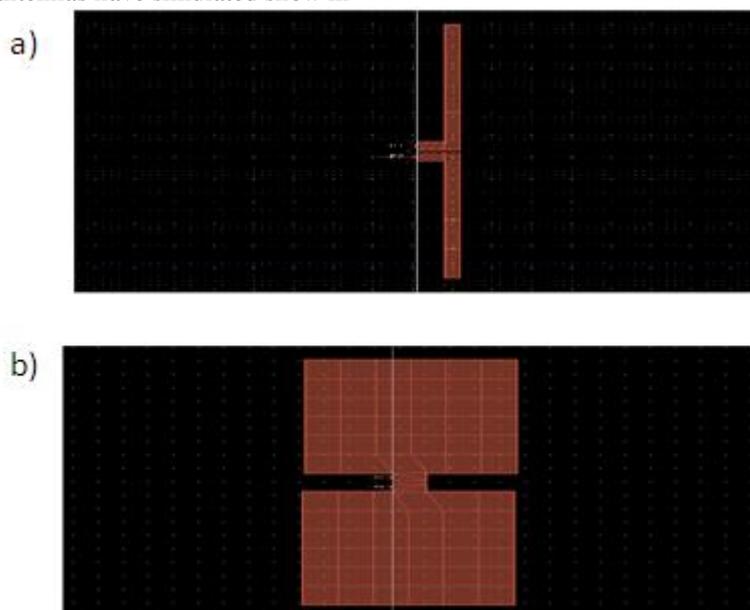

Fig 1. a) Dipole antenna, b) Basic square antenna (different shapes), c) circular disc antenna

Design process can divide into different step, which are: As a first step we want to obtain the desired bandwidth: 2,5 GHz from6GHz to 8,5GHz.In terms of the antenna, it means we have to change its length. So we will firstly create the 5,5mm antennas and we will change this value until obtained the desired BW. Once we fulfil the first requirement. We have to obtain a specific value for Zin, which is 100 Ω, at least for the central frequency. It means the space should change between the two parts of the antenna.

2.4 ANTENNA SIMULATIONS

Layouts of the different antennas have simulated show in

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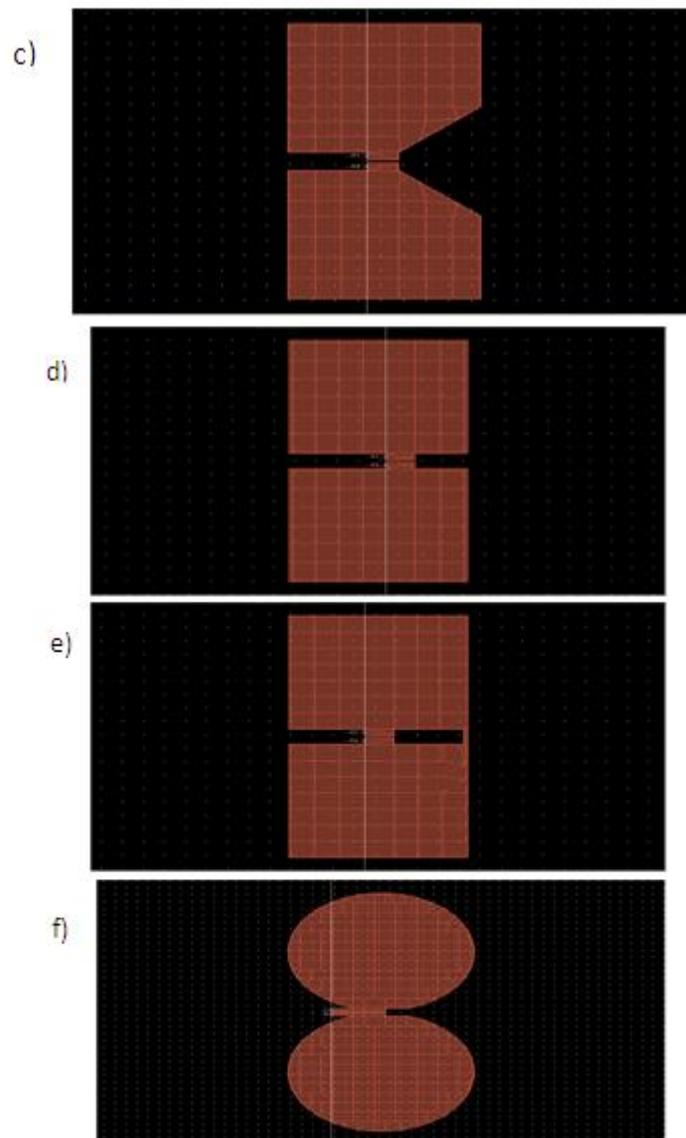
Fig2. a) Dipole antenna, b) Basic square antenna, c) Square antenna with bevel, d) square antenna withoffset, e) square antenna with pin, f) circular disc antenna

4. RESULTS, DISCUSSION AND ANALYSIS

In this section we study the different antennas we have seen in the layout, and we look for the best antenna of each type, by taking into account the requirements for them.Design for a desired bandwidth means studying VSWR. There are several ways to define the BW from VSWR, the most common is by using VSWR=2 or VSWR=3.To understand these values, we have to think in the formula thanks to which we can calculate this value:

$$VSWR = \frac{1 + |\Gamma|}{1 - |\Gamma|}$$

Which means the lower is the reflection coefficient, Γ (which ideal value is 0, no reflection), the bigger is VSWR, and it means our antenna is better. VSWR=2 and 3 are the standard values because we have enough power which is transmitted. From these values we choose VSWR=2 to work with. It is also important to know that in theory we should have at least one frequency on which VSWR=1. But in practice it is acceptable to have VSWR=1, 5.If we cannot get this value means the chosen terminal impedance for the antenna is not the correct one. We start the simulations by the 5,5mm reference antenna this value was calculated in calculating section above, but the antenna in this case is very short, so we cannot obtain the desired bandwidth, as we can see in Fig 3. This means all the antennas will be larger than this value.
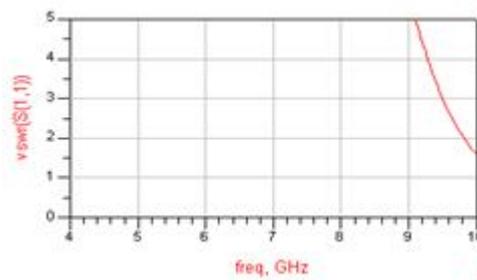
Fig 3. VSWR graph for 5,5mm dipole antenna

Change this value to 8mm, withut changing the antenna type, then we obtain a larger bandwidth. But this BW is still very narrow. In Fig 4 we see the bandwidth is from 7,2GHz to 8 GHz, so we are losing the lower frequencies from the desired ones.
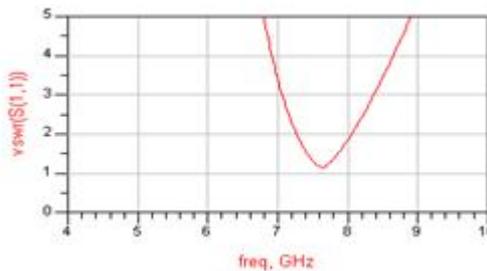

Fig 4. VSWR graph for 8mm dipole antenna

With dipole antenna, it cannot give the bandwidth need, in order to solve this problem, antenna´s shape change. With square antenna, get BW from 6GHz to 8,5GHz with an 8,5mm basic square antenna, see Fig 5. Changing the shape of this kind of antenna, as saw in the simulation part.

Fig 5. VSWR graph for 8,5mm Basic squareantenna.

It come from cut a piece from it and creating a square antenna with bevel. But now the area to take electromagnetic field (receiver) or to transmit it (transmitter) will be smaller, which means a lower bandwidth, as see in Fig 6 BW goes from 6GHz to 7,8GHz. However can increase this value, by making the bevel closer to the ground. Another possible shape can be created by changing the reference of the square antenna, it means the vertical symmetry disappears.

Fig 6. VSWR graph for 8,5mm square antenna with bevel.

Now the bandwidth is very large, look at Fig 7, it starts in 6GHz and cannot see the end in the graph because we selected a smaller frequency range than the antenna works on, so if we want to use this antenna in the real life, we must introduce a filter in order to not disturb applications in the range of interfering.
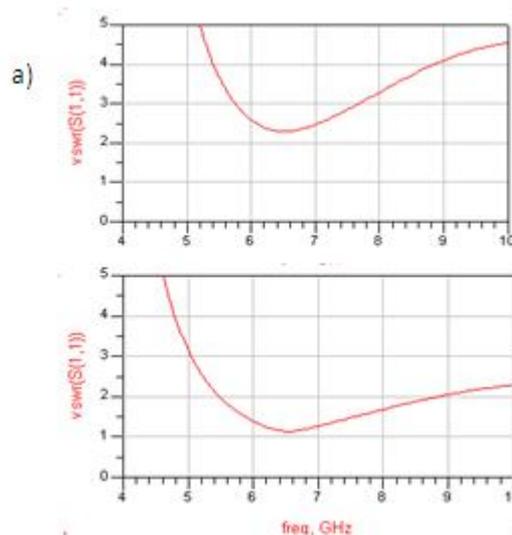
Fig 8. a) VSWR graph for 8,5mm square antenna with pin-50 Ω terminal impedance-, b) VSWR graph for 8,5mm square antenna with pin-100 Ω terminal impedance.

If square parts join both of this antenna by one side, in order to get an antenna with pin. In Fig 8a, it can see VSWR becomes worse, because its VSWR smallest value is bigger than (1.5). This is because it have used the same terminal impedance as in the rest of the cases (50 Ω). In Fig 8b) it can see the requirement for VSWR is fulfil, and the bandwidth is narrower than in case a). As well VSWR´s value is the smallest we have obtained, so in a very narrow range there is almost not any reflection. To compare the different square antennas, and notice that the broadest bandwidth is obtained with the square antenna with offset while the narrowest is given by the basic square antenna, however for our case of study all of them allow to have their desired bandwidth.
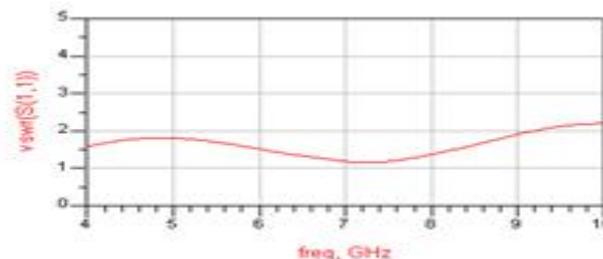

Fig 9. VSWR graph for 8,5mm circular disc antenna.

There is another antenna in this study case, which is the circular disc antenna. As with the basic square antenna, or the square antenna with offset, it can achieve the desired bandwidth, look at Fig 9. Even more, here it can notice VSWR to measure the bandwidth is (1.5). It means this antenna will have less reflection than the square. If there are comparisons of the previous antennas, the worst is the reference antenna, because the bandwidth is so narrow that it doesn't obtain the needed bandwidth. Square antenna allows us to have the bandwidth we need with all the shapes as well as circular disc antenna, but the second one gives us VSWR lower, which is an important characteristic for an antenna.

5. CONCLUSIONS

In this paper six antennas have been studied, by taking into account bandwidth (VSWR) parameter as measurement of their validity in the range we want to apply them, which is from 6GHz to 8,5GHz.In each section the different features have been discussed, and from them some conclusions can be extracted. The narrowest bandwidth is given by the dipole antenna, which cannot cover our range. With the rest of the antennas, we can fulfil our requirement. Even more, with the square antenna with pin we get VSWR very close from the ideal value. From these conclusions, it conclude that the best of the antenna for UWB in the frequency range from 6GHz to 8,5GHz is the circular disc antenna.

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