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Design of Ultra Wideband Circular Patch Monopole Antenna

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***Abstract*—This paper consist novel compact ultra wide band frequency coplanar waveguide fed coplane monopole antenna which works in application of WLAN.The antenna is optimized with Finite Element Method using CST microwave studio software, in result which provides ultra wide impedance bandwidth. As the simulation results good band operation above the 1.7 GHz which covers all the above frequency from it and able to works on frequency range of L,S,C,X,K,Ku,Ka and WLAN operating band. The Antenna provides all the results performance as Farfield radiation patternVSWR, gain over the entire operating band range have been**

***Keywords*— *Circular Monopole Antenna, UltraWideBand antenna, Microstrip Antenna, Impedance Bandwidth, Gain, CST*.**

I. INTRODUCTION

Coplanar waveguide monopole antenna are utilized for the wideband application communication system.Where as monopole are of different shapes and various size-rectangular ,triangular, circular, etched,truncated etc[1]. These are very easy in geometry radiation pattern having omnidirectional above the plane of antenna also having wider impedance bandwidth.These antennas are able to work on more than single frequency range for receiving or the transmitting of electromagnetic waves. These antennas are called as multiband Antenna, triband, quadband also pentaband etc. Multiband Antenna are having much complex to design structure and operation and this antenna is designed for ultra wideband frequency bandwidth[2].

This paper works on the ultra wide band above the 2GHz , inset cut[3] is provided to the coplanar microstrip waveguide feed to circular patch. The monopole antenna is excited with waveguide port having simple, sober structure configuration. Modified ground is provided at the bottom of substrate, a circular cutslot is made on the patch at the center of 4.6 lambda radius.

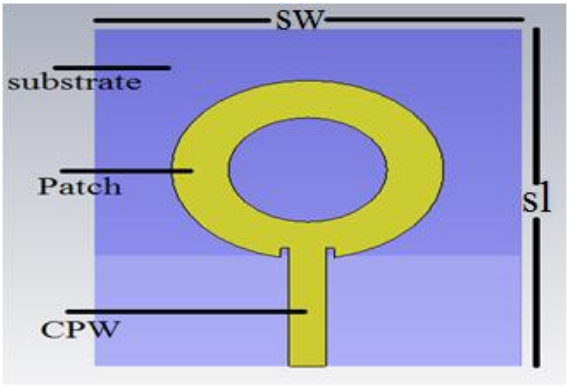
Coplanar fed[4] monopole antenna is optimized to achieve extremely very wide impedance ultra bandwidths with acceptable radiation pattern performance. This Antenna is developed to maintain several operating frequency bands of wireless communication from GSM900: 890-960 MHz, DCS: 1.71-1.88 GHz, Personal Communication System (PCS 1.85-1.99 GHz, Universal Mobile Telecommunication System (UMTS 1.92-2.17 GHZ), IMT-2000 of L,S,C,X,Ku,K,Ka,WLAN as well as military purpose also.

This antenna provides impedance bandwidth above 2GHz which is applicable in Global Positioning System, communication for use in GSM mobile phones operate at 800–900 and 1800–1900 MHz according to IEEE standard allotted frequency spectrum. Also applicable for many other government and commercial applications such as mobile radio and wireless communications[5].

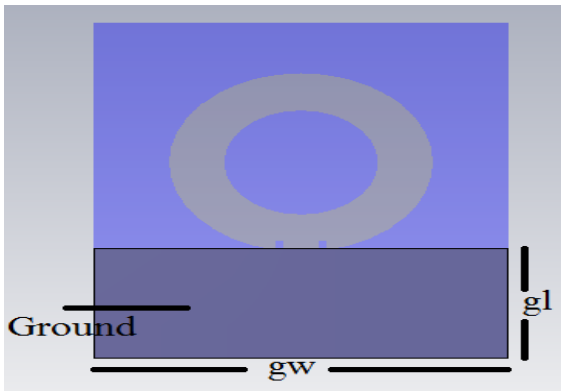
The parameters[6] of the antenna such as return loss, radiation efficiency, directivity and gain are determined using CST (Computer Simulation Technology) Microwave Studio software

II. ANTENNA DESIGN

The Design of the proposed ultra wideband monopole Antenna[7] with modified ground surface plane is shown in figure 1. Below.



Front View



Back View

Fig1.Design of the proposed ultra Band monopole Antenna.

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The antenna has the circular patch[8] of radius (R) where this patch has circular shaped slot of radius (r) cut is put on the circular monopole antenna with coplanar feeding line are printed on the dielectric substrate FR4 of thickness (h) 2.18 mm with a relative permittivity (ϵ_r) of 4.3 where ground plane is printed on below of dielectric substrate having ground width of 50mm and ground length gl of 19.675mm.The substrate length (sl) is 65mm and substrate width (sw) is 50mm in which feeding strip (Ls) and width of feeding strip(Ws) is given feeding to patch. The patch has the inset cut across the feeding strip.The antenna dimensions were obtained for ultra wideband applications are shown in Table 1.

Table 1

Dimensions of proposed monopole antenna

Parameter		Dimension (mm)
Length of substrate	sl	60
Width of substrate	sw	50
Length of Ground Plane	gl	19.65
Width of Ground Plane	gw	50
Length of Feeding Strip	Ls	19.06
Width of Feeding Strip	Ws	4.3025
Radius of Circular Monopole	R	15.94
Radius of circular Slot cut	r	9. 3

III. SIMULATION RESULTS

The proposed monopole antenna with semiground plane is simulated by the use of the CST Microwave Studio software. Figure 2 shows the simulated result of return loss S11 of the proposed antenna design fabove 1.7GHz. It is clearly manifest that the simulated return loss of proposed antenna is -33dB maximum at a resonant frequency of 10GHz and antenna bandwidth is extremely very large like a high pass filter.

The radiation pattern of proposed antenna at a frequency of 4.34GHz is shown in figure 3. The directivity and gain of proposed antenna at a resonant frequency are 5.09 dB and 4.37dB respectively.

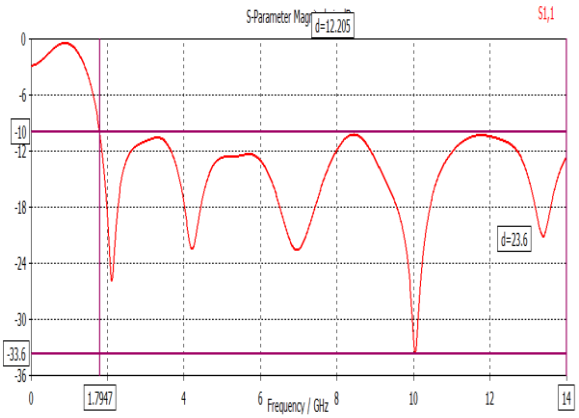

Fig2. Simulated return loss S11 of the proposed Monopole antenna

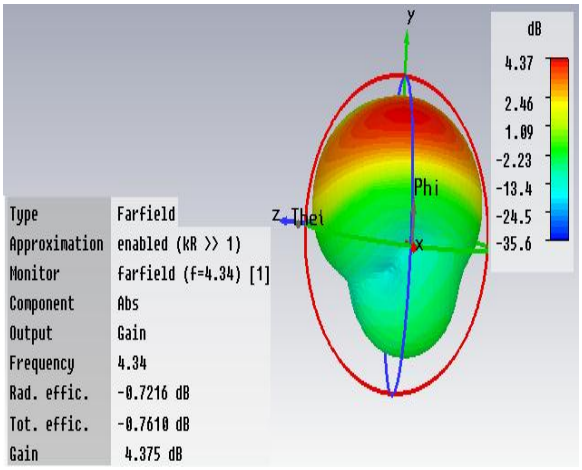

Fig 3. Simulated radiation pattern Gain 4.37dB of the proposed monopole antenna at 4.34GHz

The proposed antenna are analyzed for the Important parameters which affects the bandwidth of the antenna. In this antenna structure, feed width circular monopole patch is mainly effects the bandwidth of antenna. The feed width is varied according to the change in the values of impedance bandwidth. Figure 4 shows the simulated return loss of the proposed antenna with different feed width (fw) with all the remaining parameters of the proposed antenna are same as the design shown in figure 1.

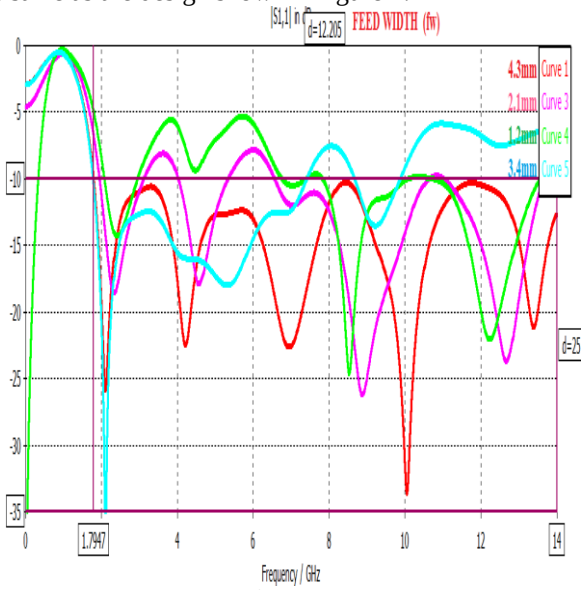

Fig 4. Simulated return loss of the proposed Monopole antenna as a variation in feed width.

The effect of the ground length (gl) of circular monopole patch of the proposed Monopole antenna is also studied. Here, remaining parameters of the proposed antenna are same as in the design shown in Table 1. The simulated return loss of the proposed Monopole antenna with the different ground length of circular monopole patch is shown in figure 5.

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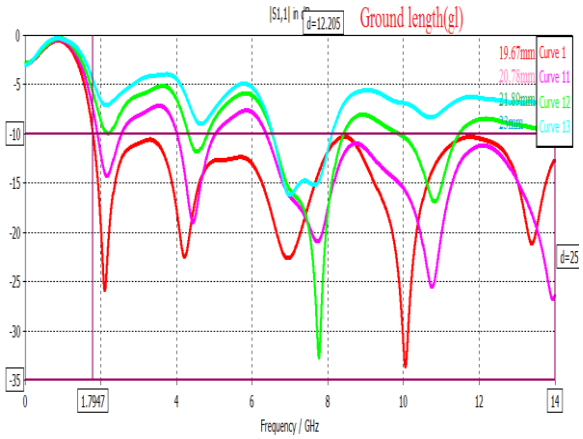

Fig 5. Simulated return loss of the proposed circular monopole patch as a variation in ground length(gl).

The antenna result VSWR of the proposed circular monopole antenna for ultra wide band applications is shown in figure 6. It is clearly seen from the figure 6 that the antenna VSWR is below .

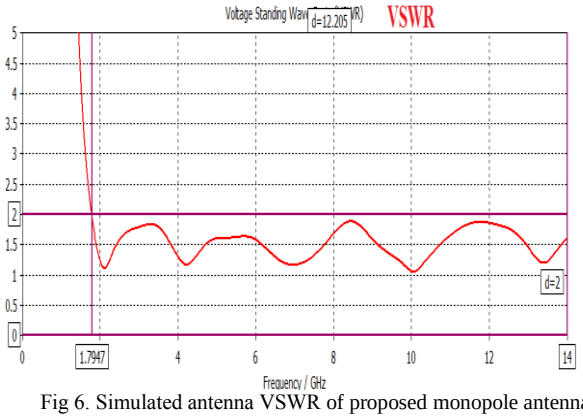

Fig 6. Simulated antenna VSWR of proposed monopole antenna.

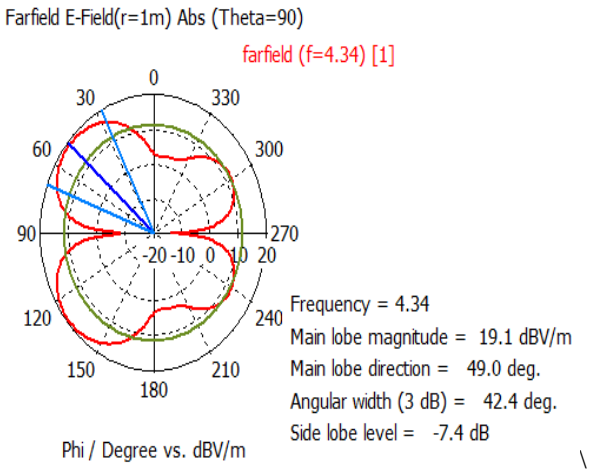

Fig7.Simulated antenna E-field radiation pattern of proposed monopole antenna.

IV. CONCLUSION

Design of circular patch monopole antenna with an circular cut fabricated on the FR4 lossy substrate with modified ground plane has been investigated for above the L band frequency application. The return loss with good antenna parameters like directivity, gain and Omni-directional radiation pattern is achieved. The antenna designing parameters such as feed gap and circular monopole radius is also investigated. After analysing the parameters it is found that the feed width, ground length and radius of circular monopole patch is a frequency dependent parameter which effects the bandwidth of the antenna. The UWB is low transmission powers over large frequency band. Because of the low transmission power, UWB communications [9] have short ranges so they are suitable for Wireless Personal Area Networks (WPAN) an application that needs high bit rates. An example is the IEEE 802.15.3 standard. This Antenna able to work for the frequency above 1.7 GHz for entire range, This Antenna is developed to maintain several operating frequency bands of wireless communication from DCS: 1.79-1.88 GHz, Personal Communication System (PCS 1.85-1.99 GHz, Universal Mobile Telecommunication System (UMTS 1.92-2.17 GHZ), IMT-2000 of L, S, C, X, Ku, Ka, WLAN as well as military purpose also.All the results are simulated in CST (Computer Simulation Technology) Microwave Studio software[10].

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