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Design of Finite Ground Coplanar Waveguide (FGCPW) fed Strip Monopole Antenna For WLAN Applications

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ABSTRACT: A Finite Ground Coplanar Waveguide (FGCPW) fed Strip Monopole Antenna has been analyzed to produce narrow band response. The effect of ground plane dimensions and feed offset on the radiation characteristics has been studied in detail. The antenna exhibits linear polarization and nearly omnidirectional radiation characteristics with moderate gain and efficieny. The parametric analysis along with the experimental results predicted the finite ground co-planar waveguide-fed strip monopole antenna as an efficient radiator and can be used for modern wireless communication systems.

In the proposed work, The antenna consists of a coplanar wave guide designed for 50Ω input impedance, fed with an SMA connector. The antenna is designed using FR-4 substrate (εr = 4.4) for a resonant frequency 5.48 GHz.By adding additional L and T shape to the initial monopole the variation of in the resonant frequency is observed.Due to this effect, the antenna can produce a narrow band response.

Key Terms: Monopole antennas,WiMAX and WLAN, VNA

I. INTRODUCTION

The wireless communication industry is integrating a number of services like Bluetooth, WLAN etc to the hand held communication devices. Therefore, in the present scenario, the bandwidth requirement of the antenna while maintaining the compactness becomes more critical [1]. Transmission lines are energy guiding devices that can be used to transfer electromagnetic signal from one part of the system to another [1]. The coplanar waveguide has made much attention in the high frequency researchers because of its attractive features. This chapter presents the results of the investigations carried out to find the radiations characteristics or resonance phenomena in a finite ground coplanar waveguide fed strip monopole [3]. The first part of this chapter includes results of investigations carried out to study the behavior of a finite ground coplanar wave guide fed strip [2] monopole while the second part of the chapter provides the development of a T shape and L shaped monopole antenna from the strip monopole. A parametric study which depicts the effect of various antenna parameters is carried out and conclusions are made from the results [4]. The analysis includes simulation studies using Ansoft HFSS and measured results with Vector Network Analyzer.

II. ANTENNA DESIGN

A.With monopole feedlength 21mm

The analysis of finite ground coplanar waveguide fed monopole antenna is presented in this session. The antenna consists of a coplanar wave guide designed for 50Ω input impedance, fed with an SMA connector. The center conductor of the FGCPW is extended to form a strip monopole of dimension 'Lm'.

The initial design parameters for the FGCPW fed strip monopole antenna are, Lg = 19mm, Wg = 19mm, g = 0.35mm, Wc = 3mm and Lm = 21mm. The geometry of the strip monopole antenna is depicted in fig. 1.

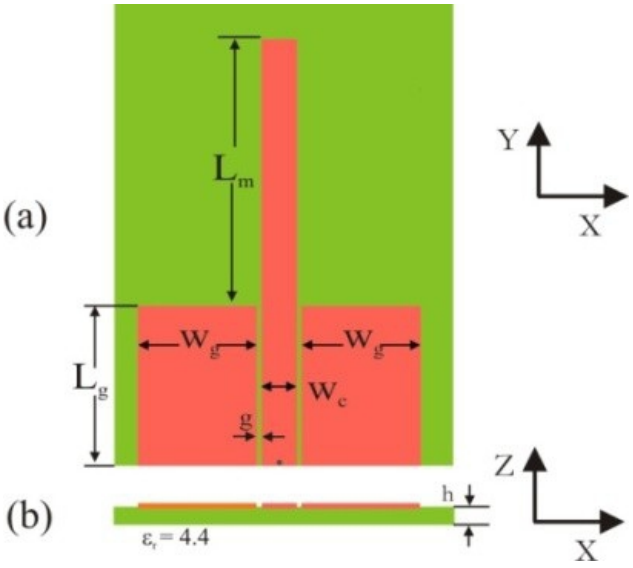

Fig. 1. Geometry of proposed antenna.

Fig. 1 Geometry of the Finite Ground Coplanar Waveguide Fed Strip Monopole Antenna. The optimum parameters are obtained with the aid of Ansoft HFSSv12 software. Photograph of the fabricated prototype is shown in Fig. 2.

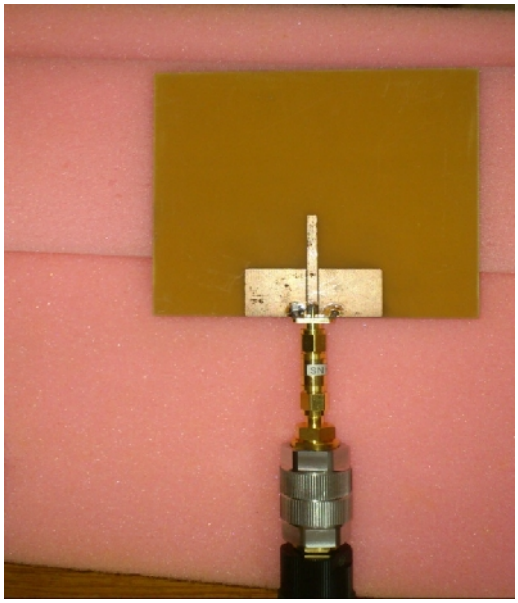

Fig. 2. Photograph of the proposed antenna.

B. With monopole feedlength 22mm

The analysis of finite ground coplanar waveguide fed monopole antenna is presented in this session. The antenna consists of a coplanar wave guide designed for 50Ω input impedance, fed with an SMA connector. The center conductor of the FGCPW is extended to form a strip monopole of dimension 'Lm'. The initial design parameters for the FGCPW fed strip monopole antenna are, Lg = 19mm, Wg = 19mm, g = 0.35mm, Wc = 3mm and Lm = 22mm. The geometry of the strip monopole antenna is depicted in fig. 3

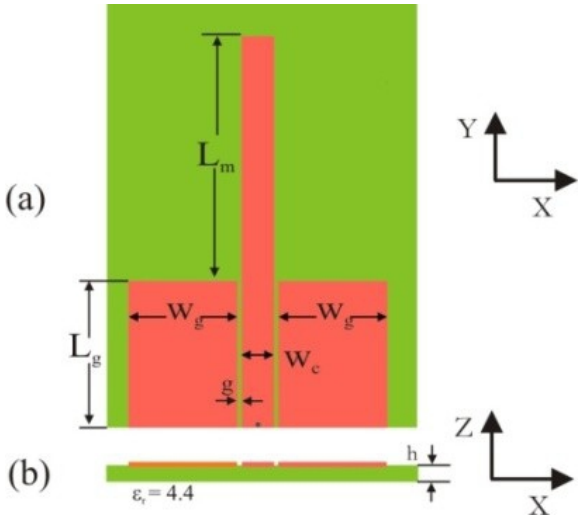

Fig. 3. Geometry of proposed antenna.

Fig. 2 Geometry of the Finite Ground Coplanar Waveguide Fed Strip Monopole Antenna.(Lg = 19mm, Wg = 19mm, g = 0.35mm, Wc = 3mm, Lm = 22mm, h =1.6mm and εr = 4.4). The optimum parameters are obtained with the aid of Ansoft HFSSv12 software. Photograph of the fabricated prototype is shown in Fig. 4.

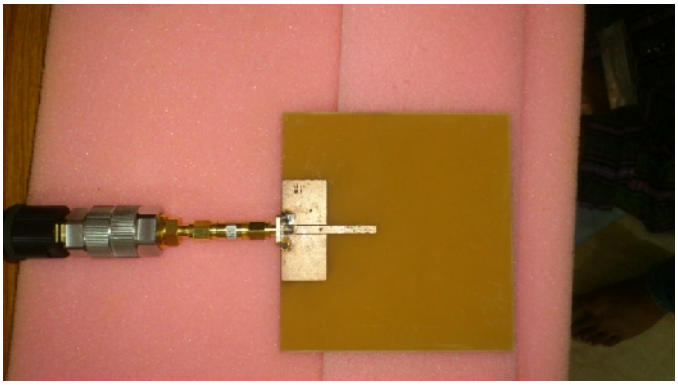

Fig. 4. Photograph of the proposed antenna.

C. L shape monopole

The analysis of finite ground coplanar waveguide fed monopole antenna is presented in this session. The antenna consists of a coplanar wave guide designed for 50Ω input impedance, fed with an SMA connector. The center conductor of the FGCPW is extended to form a strip monopole of dimension 'Lm'. The initial design parameters for the FGCPW fed strip monopole antenna are, L = 13mm, W = 3mm, gap between the ground plane and monopole = 0.35mm, W1 = 3mm, LG = 20mm and WG = 20mm. The geometry of the strip monopole antenna is depicted in fig. 5

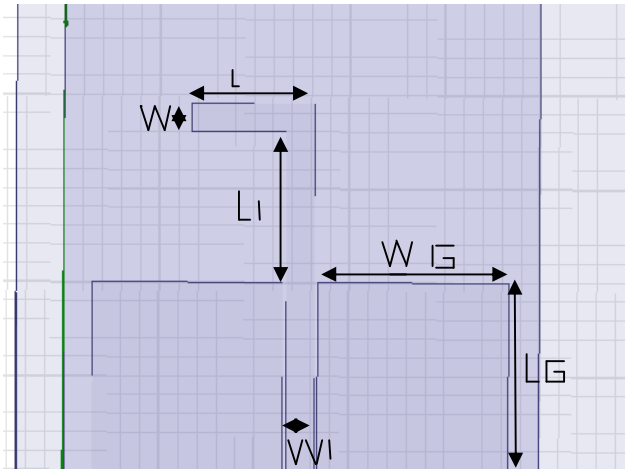

Fig. 5. Geometry of proposed antenna.

Fig. 3 Geometry of the Finite Ground Coplanar Waveguide Fed Strip Monopole Antenna.(L = 13mm, L1 = 16mm, W = 3mm, gap between the ground plane and monopole = 0.35mm, W1 = 3mm, LG = 20mm and WG = 20mm, h = 1.6mm and εr = 4.4). The optimum parameters are obtained with the aid of Ansoft HFSSv12 software. Photograph of the fabricated prototype is shown in Fig. 6.

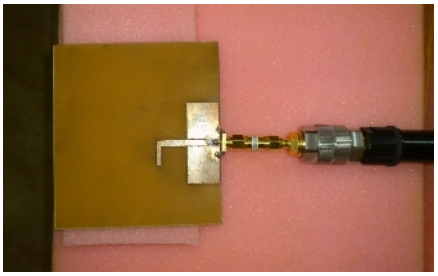

Fig. 6. Photograph of the proposed antenna.

C. T shape monopole

The analysis of finite ground coplanar waveguide fed monopole antenna is presented in this session. The antenna consists of a coplanar wave guide designed for 50Ω input impedance, fed with an SMA connector. The center conductor of the FGCPW is extended to form a strip monopole of dimension 'Lm'. The initial design parameters for the FGCPW fed strip monopole antenna are, L = 23mm, W = 3mm, L1 = 19mm gap between the ground plane and monopole = 0.35mm, W1 = 3mm, LG = 20mm and WG = 20mm. The geometry of the strip monopole antenna is depicted in fig. 7.

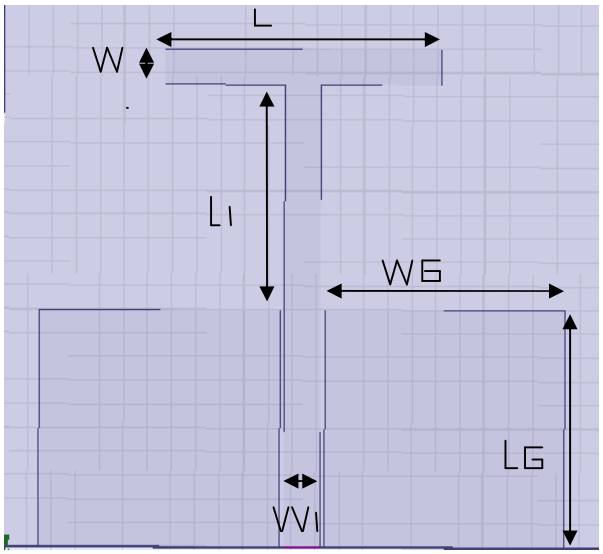

Fig. 7. Geometry of proposed antenna.

Fig. 7 Geometry of the Finite Ground Coplanar Waveguide Fed Strip Monopole Antenna.(L = 23mm, L1 = 19mm,W = 3mm, gap between the ground plane and monopole = 0.35mm, W1 = 3mm, LG = 20mm and WG = 20mm, h =1.6mm and εr = 4.4).

The optimum parameters are obtained with the aid of Ansoft.

III. RESULTS

The simulated parametric study results and return losses for the proposed monopole antenna are obtained. The simulated return losses are presented for the optimized set of antennaparameters in Figures.

(a) SIMULATED RESULTS

A. With monopole feedlength 21mm

The proposed antenna is simulated in Ansoft HFSS v12 software and the results obtained are shown below,

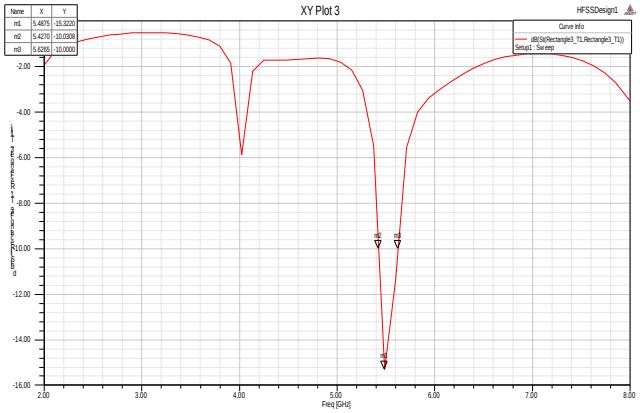

Fig. 8. Simulated Return loss characteristics(in Ansoft HFSSv12).

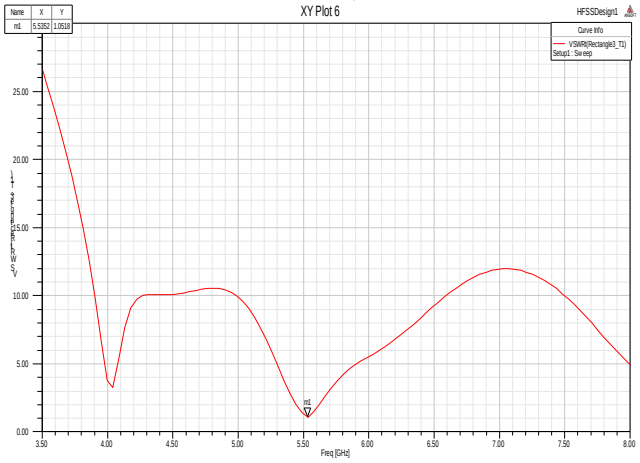

Fig. 9. Simulated VSWR characteristics.

B. With monopole feedlength 22mm

The proposed antenna is simulated in Ansoft HFSS v12 software and the results obtained are shown below,

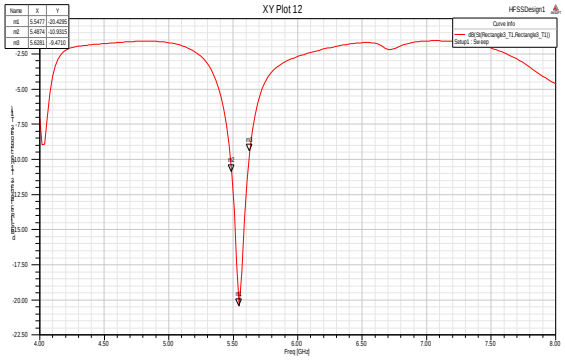

Fig. 10. Simulated Return loss characteristics(in Ansoft HFSSv12).

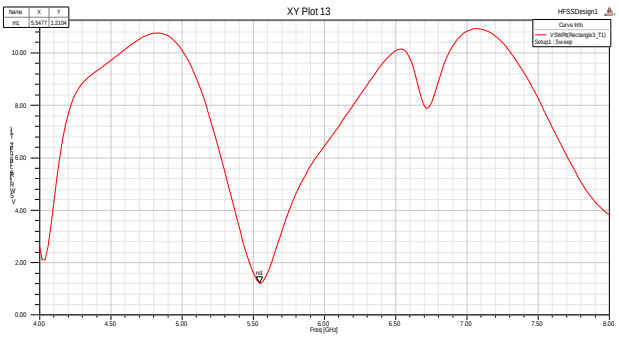

Fig. 11. Simulated VSWR characteristics.

C. L shape monopole

The proposed antenna is simulated in Ansoft HFSS v12 software and the results obtained are shown below,

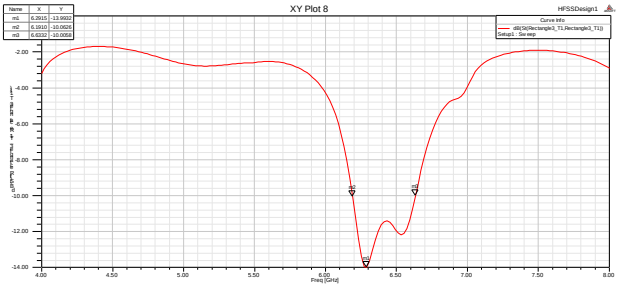

Fig. 12. Simulated Return loss characteristics(in Ansoft HFSSv12**).**

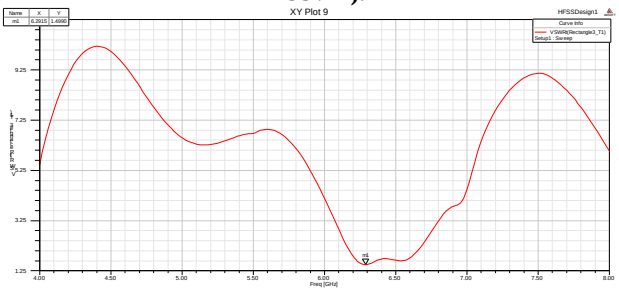

Fig. 13. Simulated VSWR characteristics.

D. T shape monopole

The proposed antenna is simulated in Ansoft HFSS v12 software and the results obtained are shown below,

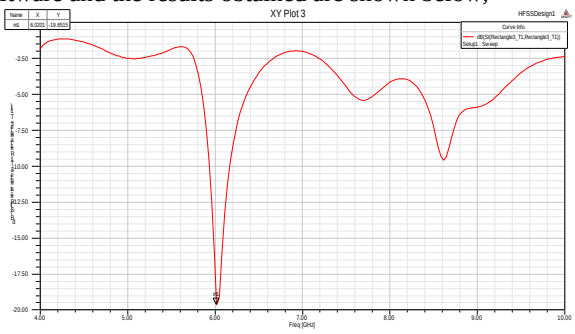

Fig. 14. Simulated Return loss characteristics(in Ansoft HFSSv12).

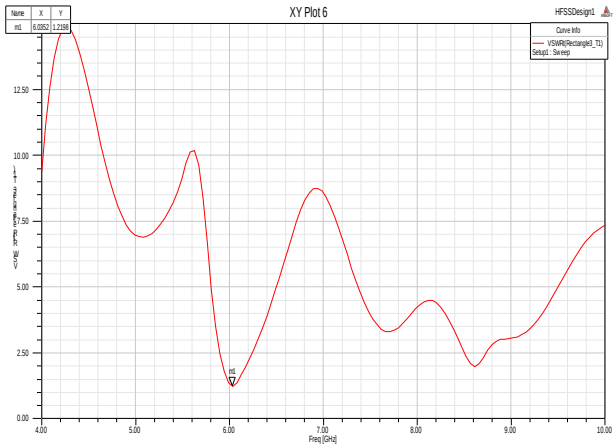

Fig. 15. Simulated VSWR characteristics.

(b). PRACTICAL RESULTS

The proposed antenna is fabricated and its practical results are obtained using Vector Network Analyzer(VNA)-E5071C,and the results are shown below

A. With monopole feedlength 21mm

The proposed antenna results obtained are shown below,

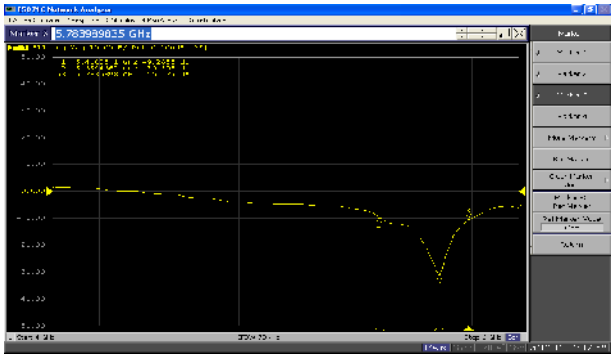

Fig. 16. Simulated Return loss characteristics(in Ansoft HFSSv12).

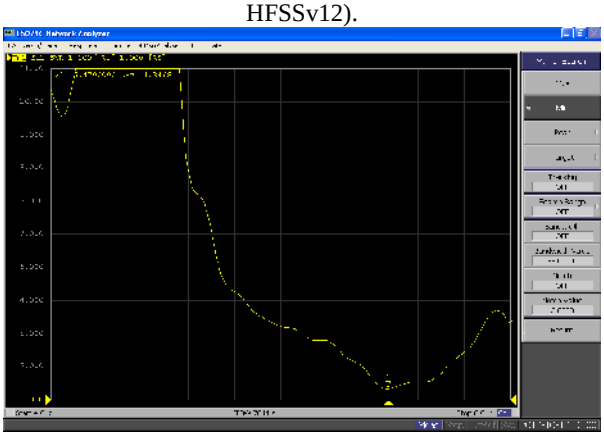

Fig.17. Simulated VSWR characteristics.

B. With monopole feedlength 22mm

The proposed antenna results obtained are shown below

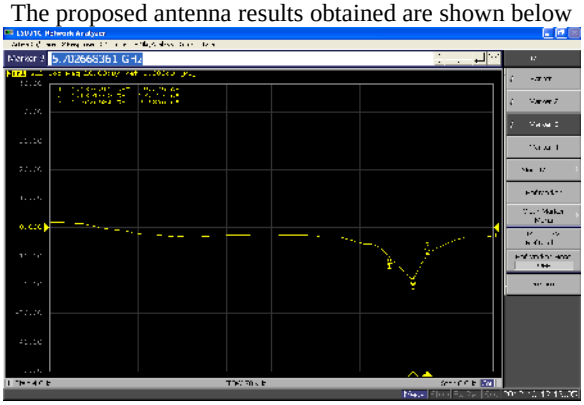

Fig. 18. Simulated Return loss characteristics(in Ansoft HFSSv12).

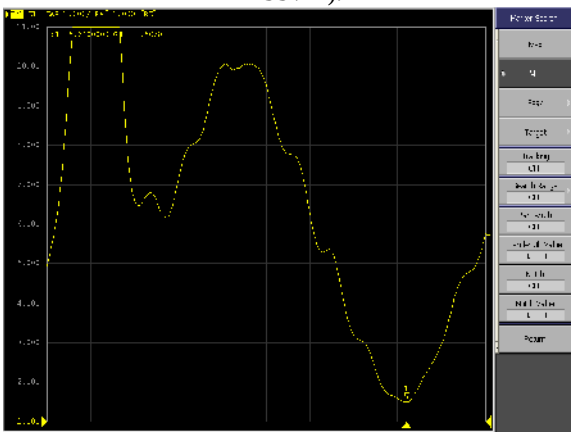

Fig. 19. Simulated VSWR characteristics.

C. L shape monopole

The proposed antenna results obtained are shown below

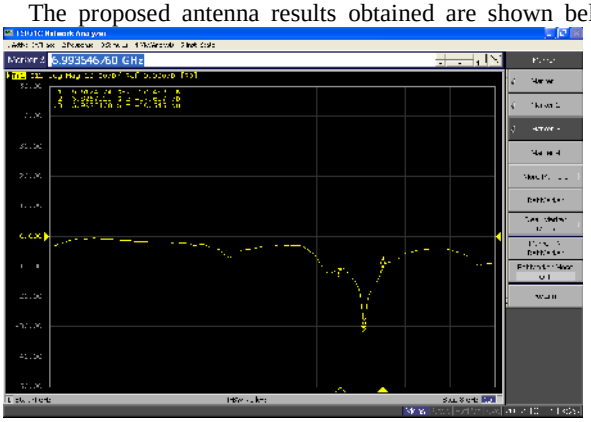

Fig. 20. Simulated Return loss characteristics(in Ansoft HFSSv12).

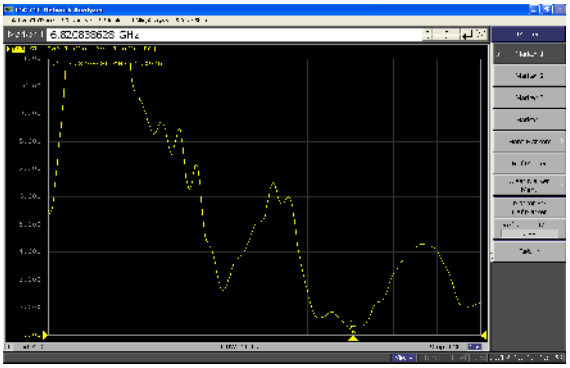

Fig. 21. Simulated VSWR characteristics.

D. T shape monopole

The proposed antenna results obtained are shown below

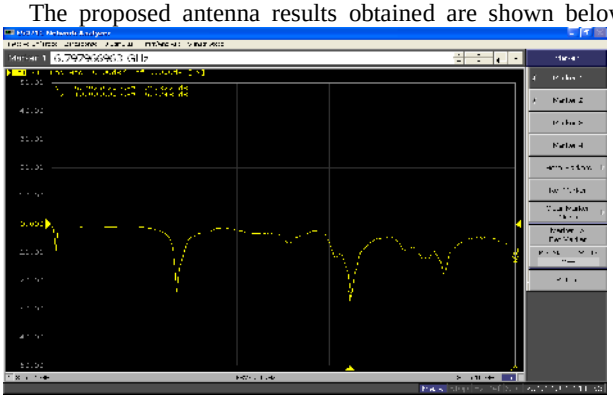

Fig. 22. Simulated Return loss characteristics(in Ansoft HFSSv12).

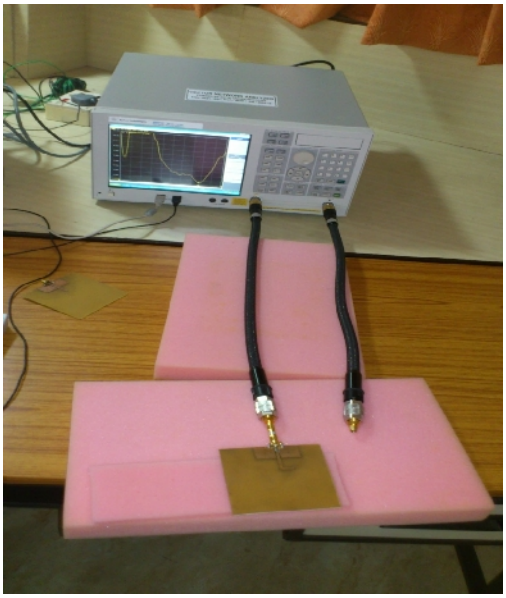

Fig. 23. Proposed antenna connected to Vector Network Analyzer(E5071C).

IV. CONCLUSIONS

A Finite Ground plane monopole antenna covering WiMAX and WLAN bands is proposed. The various parameters of the proposed antenna are optimized through simulation. Prototype of the proposed antenna has been designed, simulated in Ansoft HFSSv12 software and the fabricated Antenna is tested using Vector Network Analyzer(VNA).
The practical return loss bandwidths observed in Vector Network Analyzer are observed monopole is resonating at 5.84GHZ GHz wih the improvement of return loss.. The proposed antenna provides In the United States, seven frequency bands have been allocated by the Federal Communications Commission for uses that include cordless phones 5.8 GHz (allocated in 2003 due to crowding on the 2.4 GHz band). These are:nearly omni-directional radiation characteristics with moderate gain and efficiency which is suitable for the next generation wireless communication gadgets.

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