International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 08, 2020
ISSN: 1475-7192

Design and Fabrication of single band monopole antenna for WLAN applications

[1]Yousif Jawad Kadhim Nukhailawi, [2]Mohammed Abdulmahdi Mohammed ali, [3]FAHAMA Hassoon Salman, [4]Ayad Muslim Hamzah

***Abstract*—** This paper introduces a 2.4GHz single-band antenna design. Suggested antenna dimensions are: (31mm x 21mm) for one band. The antenna characteristics, such as gain, long-range radiation patterns and the coupling coefficient, are expressed in the scattering parameter S11. Design and simulation are implemented using FIT-based CST Microwave Studio.

***Keywords*—** WLAN applications, monopole antenna, wireless communication, CST Microwave Studio.

I. Introduction

The wireless communications has been rapidly growing and developed, is become an urgent necessity it's now more and more common being developed as quickly and constantly as the new developments [9]

The competition now consists of manufacturing small antennas at high speeds. One of the types that provides these requirements is a printed antenna for simple, low-cost manufacturing. Therefore, Microstrip antennas are used in many applications, particularly in the fields of medical, medical, military, mobile and satellite communications. Its small size and light weight make it versatile.[13].

The antenna gain(AG) and return losses (S11) achieved by the flexible antenna(FA) presented by Zhang et al.[12] were 1.4 dB and -19.8 dB respectively at 2.4 GHz while the design proposed by this paper attain a 2 dBm of AG and around -32.5 dB of S11 at same frequency band which intend our design more efficient than FA in these important points of view.

authors are using different proposed antenna's shapes such as E[1] , C[2] , T[3] , L[4] , B[5] , F[6] , G[7] and U Shaped [8] for example for U shaped antenna which is used with substrate is 2.2 and 0.0009 respectively [8].

one of the most advantage of this material has low cost with good mechanical properties [10] FR-4 proposed to use with antennas that working with X-band (Frequency range 8.0 – 12.0 GHz) [11] , in this paper FR-4

[1] Technical Institute of Najaf, Al-Furat Al-Awsat Technical University, Iraq.
[2] College of Health and Medical Techniques\ Kufa, Al-Furat Al-Awsat Technical University, Al-Najaf, Iraq.
[3] Technical Institute of Najaf, Al-Furat Al-Awsat Technical University, Iraq.
[4] Faculty of Electrical and Electronic Engineering, University Tun Hussein Onn Malaysia, Parit Raja, Malaysia.

Received: 03 Apr 2019 | Revised: 21 May 2020 | Accepted: 12 Jun 2020

substrate is used we designed and fabricated an "U" shape micro strip antenna which is provide frequency 2.4 G.H ,The realized gain is 2.026 dB with a B.W of 401.51MHz.

II. Antenna Config and Design

a) -*Patch Antenna*

Fig 1 presents the detailed dimension and an overview of the proposed antenna.

The substrate fr4(relative permittivity = εr=4.5 and tangent loss =0. 0009) is used, which is 1.5 mm thicker.

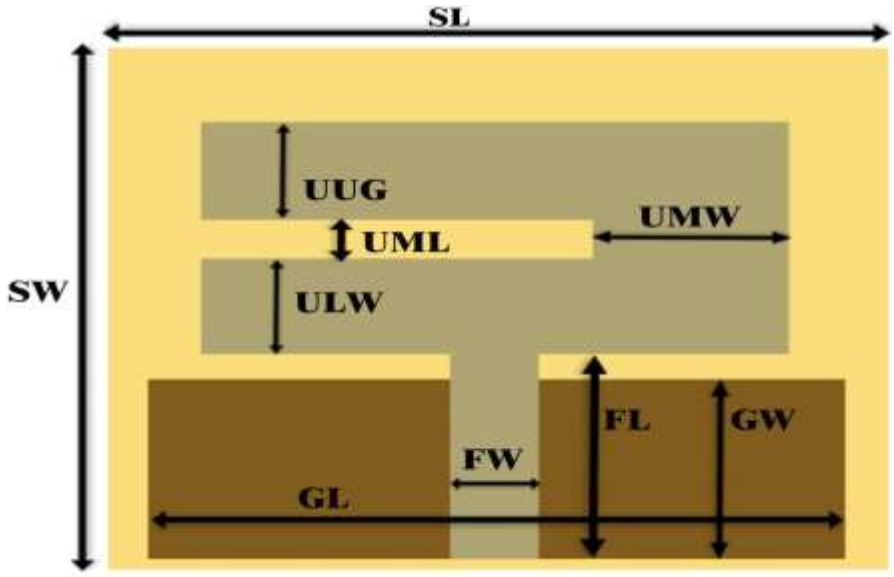

Fig. 1. Shape and dimensions of a single printed tape (millimeters)

Monopoly (the shaded area represents the corresponding ground level).

Table 1 shows the dimension of the simple patch antenna.(all in millimeters)

SL	SW	GL	GW	FL	FW	UUL	UUW	UML	UMW	ULL	ULW
28	37	25	12.5	14.5	3	21	7	2.5	7	21	7

b) *Simulation and Modeling*

The simulation and modeling of the designed antenna are performed employing CST MWS 2015. The radiating patch is supported by finite ground surface having dimension is. The inset feed mechanism technique is used for impedance matching.

Received: 03 Apr 2019 | Revised: 21 May 2020 | Accepted: 12 Jun 2020

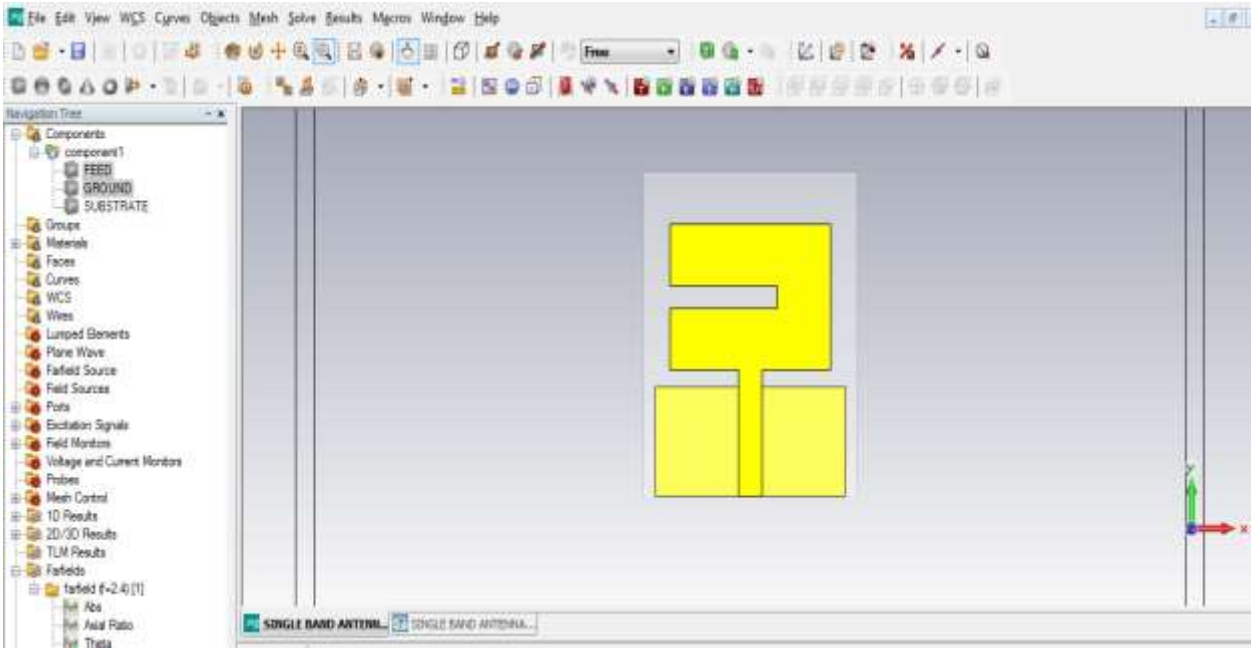

Fig. 2. Single Band Monopole Antenna configuration

c) Result and Discussion of Simple Patch Antenna

Simulation Results

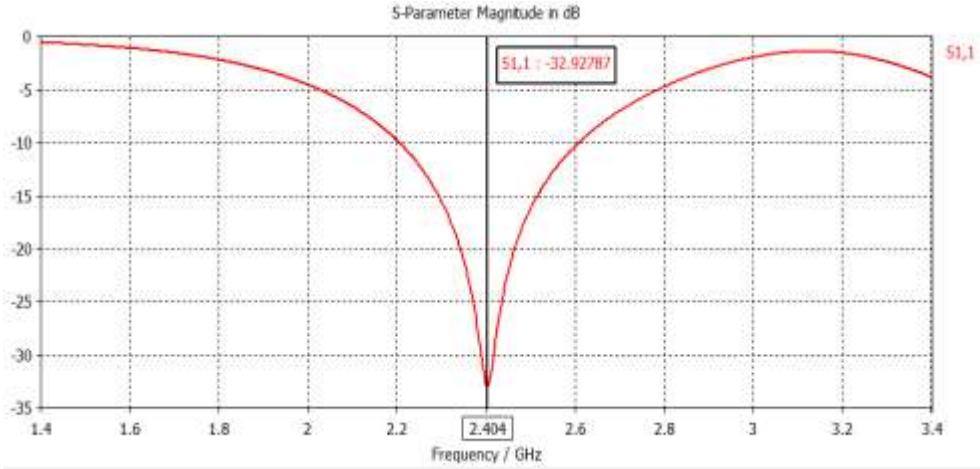

Fig. 3. The Return loss of Monopole Single Band Antenna .

Resonant frequency	2.4GHz
Return loss	-32.93 dB

Resonant frequency	2.4GHz
Band Width	401.51 MHz

Gain	1.958 dB
Directivity	2.503 dB
Resonant frequency	2.4GHz

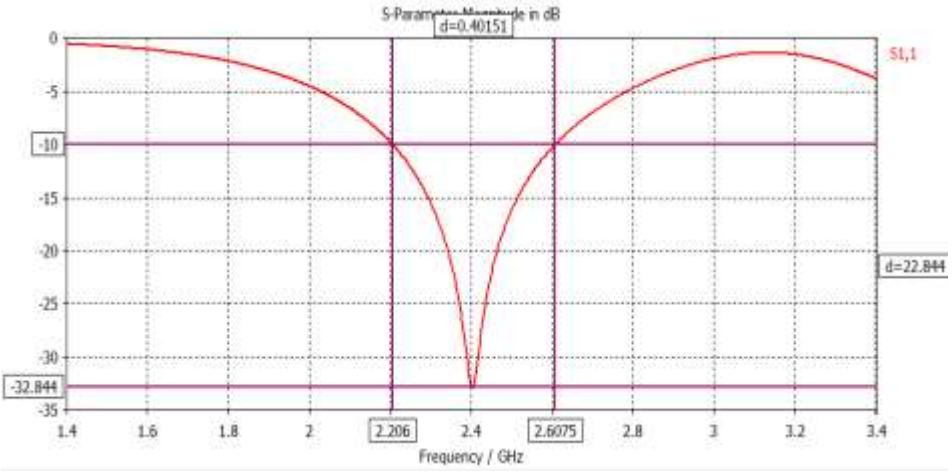

Fig .4. The Band width of Monopole Single Band Antenna at fr =2.4GHz

d) Polar Plot

The far field 3D and 2D radiation pattern of the simple patch antenna in the perpendicular and elevation plane is presented in Fig.5. The designed antenna is excited in its basic mode has a peak gain in perpendicular

direction to the patch. The peak gain and directivity value of the proposed compact patch antenna is 1.958 dB and 2.503 dBi respectively**.**

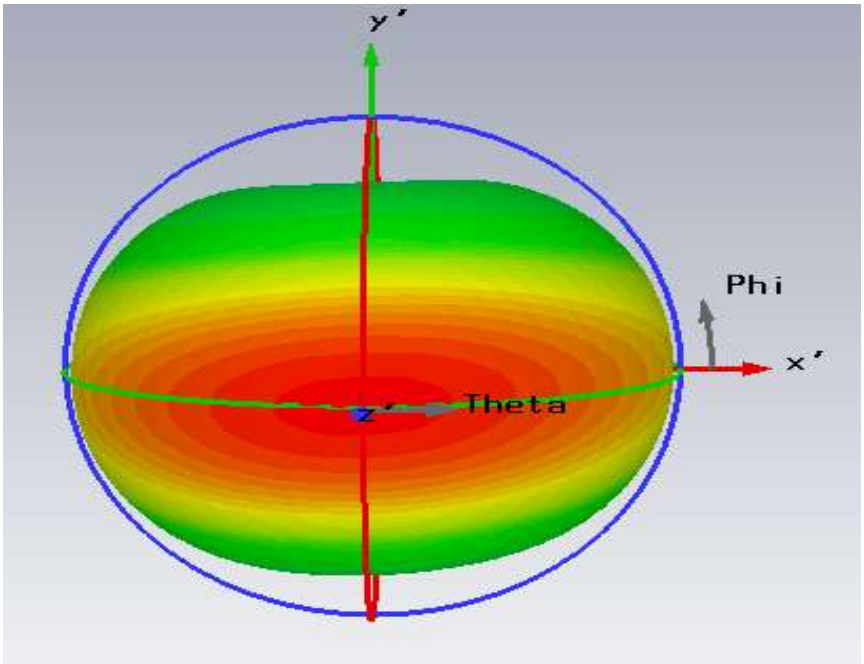

Fig. 5. the radiation pattern of monopole single band antenna .

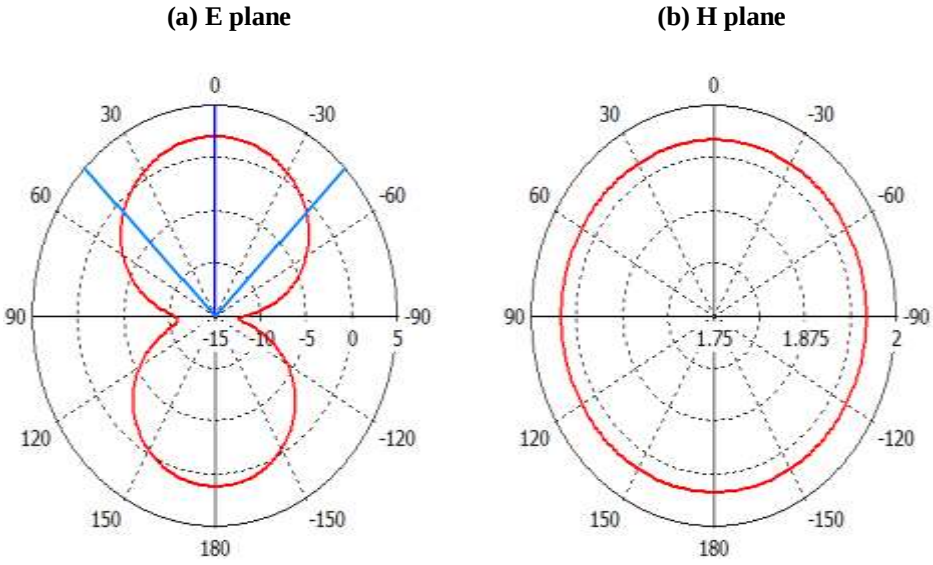

Fig 6. E plane and H plane patterns of Single band Monopole Antenna .

	E- plane	H- plane
HPBW	91º	Omnidirectional
Main lobe magnitude	1.5 dB	1.5 dB

III. Fabrication and Test Results

a) Fabrication

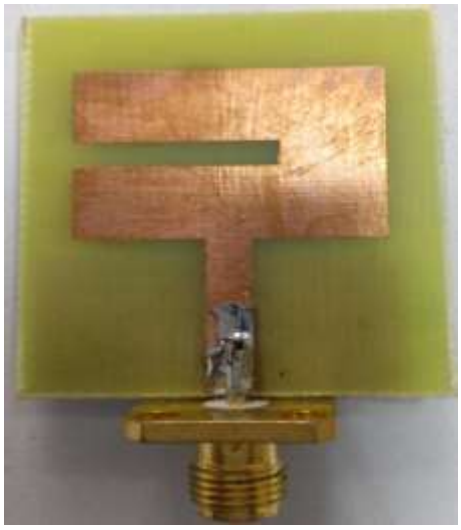

Fig. 6. Single Band Monopole Antenna Front view

Fig. 7. single Band Monopole Antenna Back view

b) *Experimental Results*

Received: 03 Apr 2019 | Revised: 21 May 2020 | Accepted: 12 Jun 2020

Fig. 8 The network analyzer with a monopole single band antenna.

Fig 8 shows Photograph of network analyzer with single band monopole antenna. Fig. 6 and 7 are front view and Back view of a proposed single Band monopole antenna respectively. The antenna responses are shown in Fig. 9.

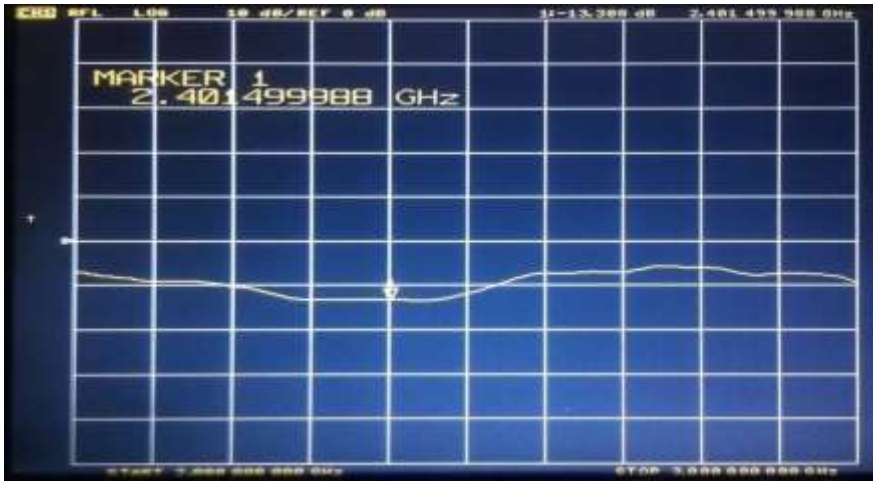

Fig. 9. The Return loss of Monopole Single Band Antenna at 2.401GHz

The return loss measured for the frequency of the proposed single band antenna is illustrated in Figure 9. The simulated S11 of the antenna is (-30 dB at 2.4 GHz) and the bandwidth is -10 dB. 401.51 MHz, the measured S11 is (-13 dB at 2.4) GHz, the bandwidth of -10 dB is 310 MHz

In addition, the radiating element has been modeled as a perfect electrical conductor (PEC) in the simulation, and the conductivity of the silver nanoparticle inks used in manufacturing is finite and extremely lower than the PEC, which reduces the efficiency of the operating band and the antenna. The size of the SMA connector also relatively affects the mismatch of the impedance bandwidth.

IV. Discuss the results:

Received: 03 Apr 2019 | Revised: 21 May 2020 | Accepted: 12 Jun 2020

Table 2 shows the Comparison of Simulated results with Experimental Results.

Type of antenna	**Simulated**		**Measured**	
	Frequency	Return loss	Frequency	Return loss
Monopole Single Band antenna	2.4 GHz	-30 dB	2.4GHz	-13 dB

V. Conclusions

The proposed antenna is a 2.4 GHz monopole single-band antenna that has been successfully simulated using the CST Microwave studio software, The behavior and characteristics of this antenna have been investigated, It was noted that single bands with good return loss characteristics were achieved, The antenna was manufactured and then tested using a network analyzer and the results were compared with that of the simulation, The results covered by the antenna can be observed for all important frequencies including the common 2.4 GHz WLAN frequencies.

References

[1] S. Ullah, S. Ahmad, B. A. Khan, U. Ali, F. A. Tahir, and S. Bashir, "Design and Analysis of a Hexa-Band Frequency Reconfigurable Monopole Antenna," *IETE J. Res.*, vol. 64, no. 1, pp. 59–66, 2018.

[2] "Progress In Electromagnetics Research C, Vol. 20, 17–29, 2011," vol. 20, no. January, pp. 17–29, 2011.

[3] Y. L. Kuo and K. L. Wong, "Printed Double-T Monopole Antenna for 2.4/5.2 Ghz Dual-Band WLAN Operations," *IEEE Trans. Antennas Propag.*, vol. 51, no. 9, pp. 2187–2192, 2003.

[4] Z. W. Yan, G. Wang, G. L. Tian, W. M. Li, D. L. Su, and T. Rahman, "The HF channel em parameters estimation under a complex environment using the modified IRI and IGRF model," *IEEE Trans. Antennas Propag.*, vol. 59, no. 5, pp. 1778–1783, 2011.

[5] H. U. Iddi, M. R. Kamarudin, T. A. Rahman, and R. Dewan, "Design of dual-band B-shaped monopole antenna for MIMO application," *IEEE Antennas Propag. Soc. AP-S Int. Symp.*, pp. 2–3, 2012.

[6] S. Hayat, I. A. Shah, I. Khan, I. Alam, S. Ullah, and A. Basir, "Design of tetra-band frequency reconfigurable antenna for portable wireless applications," *2016 Int. Conf. Intell. Syst. Eng. ICISE 2016*,

no. January, pp. 10–13, 2016.

[7] E. G. Turitsyna and S. Webb, “Simple design of FBG-based VSB filters for ultra-dense WDM transmission ELECTRONICS LETTERS 20th January 2005,” *Electron. Lett.*, vol. 41, no. 2, pp. 40–41, 2005.

[8] S. N. Azizi, N. Hasan, and M. H. Ramli, “Design and analysis of Yagi-Uda antenna for WLAN applications,” *J. Telecommun. Electron. Comput. Eng.*, vol. 9, no. 1–3, pp. 109–112, 2017.

[9] A. Rathore, R. Nilavalan, H. F. AbuTarboush, and T. Peter, “Compact dual-band (2.4/5.2GHz) monopole antenna for WLAN applications,” *Final Progr. B. Abstr. - iWAT 2010 2010 Int. Work. Antenna Technol. Small Antennas, Innov. Struct. Mater.*, pp. 3–6, 2010.

[10] J. R. Aguilar, M. Beadle, P. T. Thompson, and M. W. Shelley, “The microwave and RF characteristics of FR4 substrates,” *IEE Colloq.*, no. 206, pp. 0–5, 1998.

[11] A. A. Qureshi, M. U. Afzal, T. Taqueer, and M. A. Tarar, “Performance analysis of FR-4 substrate for high frequency microstrip antennas,” *2011 China-Japan Jt. Microw. Conf. Proceedings, CJMW 2011*, no. January, pp. 159–162, 2011.

[12] H. Zhang, D. Chen, C. Zhao, K. Wang, and Y. Yu, “A compact flexible printed monopole antenna with embedded periodic H-shaped slots for WLAN applications,” *Prog. Electromagn. Res. Lett.*, vol. 89, no. 9, pp. 61–67, 2020.

[13] A. A. Qureshi, M. U. Afzal, T. Taqueer, and M. A. Tarar, “Performance analysis of FR-4 substrate for high frequency microstrip antennas,” *2011 China-Japan Jt. Microw. Conf. Proceedings, CJMW 2011*, pp. 159–162, 2011.

Received: 03 Apr 2019 | Revised: 21 May 2020 | Accepted: 12 Jun 2020