Indian Journal of Emerging Electronics in Computer Communications
Vol.4, Issue 1 (2017) Page.608-612
ISSN: 2393-8366

Development of Single-Band Wearable Textile Antenna for WLAN Applications

A.Sivabalan
Assistant Professor,
Department of Electronic and Communication Engineering,
Chennai Institute of Technology, Chennai-600069
[1]asbalan47@gmail.com

Dr.T.K.Thivakaran
Professor,
Department of Electronic and Communication Engineering,
Sri Venkateswara College of Engineering, Chennai-600112
[2]tkt.vinayagar@gmail.com

Abstract—*Currently, antennas integrated in clothing are particularly interesting because they can employ conductive elements which are already in garments. Therefore, this study is spent on the design of a single-band textile antenna for WLAN applications. Its single-band is fed by a coplanar waveguide (CPW) configuration. The proposed antenna structure is produced from cotton fabric and operates in the 2.3 to 2.4 GHz band, at bands of 2.4 GHz, respectively, which cover the 2.4 GHz WLAN operating bands. The antenna looks like a double G form. The aim is creating two different paths for the current traversing the strips and thus creating same resonant mode depending on the electrical lengths of the strips. ADS Advanced Design Software was used to design and simulate the structure. Moreover, performances in terms of radiation pattern and gain are presented and discussed.*

Keywords— *CPW antenna; textile substrate; wearable antenna; single-band antenna; WLAN.*

I. INTRODUCTION

Nowadays, wireless communication systems need a simple structure of antennas, wide bandwidth and low cost. Furthermore, textile antennas [1-4] have taken a lot of attention during the last years due to the growing interest in portable electronics besides the rapid progress in wireless applications [5]-[6]. Currently there is a great interest in the use of the coplanar waveguide (CPW) to protect the human body against the backward radiation and improve performance of antennas such as gain, quality factor, shapes and dimensions. Antennas integrated on textiles are particularly interesting because of the conductive elements already available in the clothes [7]-[8]. Nevertheless, the problem of antenna design increases when the number of operating frequency bands grows. Until now, many antenna designs with improved dual- or multiband operation capabilities to satisfy the IEEE 802.11 WLAN were studied and presented [9]. Among these antennas, monopole CPW-fed antennas have especially received great interest than others because of their potential in providing many features such as the simple structure of a single metallic layer and easy integration. Nevertheless, for the available CPW-fed antenna design capable of single-band operated for WLAN system, some of them are with a complex structure and some are large in antenna sizes [10]. Further to this

Indian Journal of Emerging Electronics in Computer Communications
Vol.4, Issue 1 (2017) Page.608-612
ISSN: 2393-8366

trend, a single-band textile antenna using Shield it as electro-textile is presented in this study. We propose a CPW double G-shaped planar monopole antenna operated at single-band for wireless local area network (WLAN) applications. The geometry parameters of the proposed antenna, like that the dimensions of the double G-shaped strips structure, the sizes of the coplanar ground planes and the spaces between the ground plane to either the double G-shaped strips, were all optimized using CST to obtain well single-band operation.

II. SINGLE-BAND DOUBLE-G TEXTILE ANTENNA

Fig. 1 shows the geometrical configuration of the proposed antenna using as substrate a textile type "cotton" and as metal part an electro-textile type "Shield it". The antenna geometry is based from the letter G which is duplicated so that it results in a symmetrical structure. A 50Ω CPW transmission line is used for feeding the antenna; it consists of a signal strip thickness of 1.8 mm and a gap distance of 0.2 mm between the coplanar ground plane and the single strip.

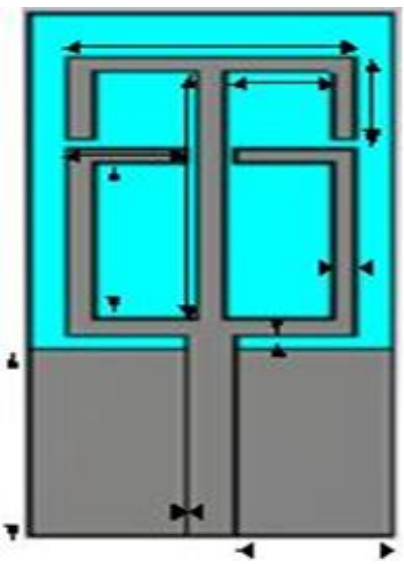


Fig. 1. Geometry of the single-band textile antenna.

The double G antenna is fed using a coplanar waveguide (CPW) configuration for obtaining single-band operation. Then, to get the two resonances frequency, we must adjust the lengths of the folded bands. The aim is creating two different paths for the current traversing the strips and thus creating two resonant modes depending upon the lengths of the strips. The CPW feed configuration ensures 50Ω input impedance by controlling the dimensions of the supply line and the slots. The antenna is etched on a cotton substrate having a permittivity of 2.45 and a loss tangent of 0.047. Shield it electro-textile is the metallic elements with high conductivity and low loss. The antenna is symmetrical respecting the longitudinal direction. The ground planes with the same size are placed symmetrically on each side of the CPW line. The antenna dimension, optimized for operations at 2.4 GHz, is presented in Table I below.

TABLE I. ANTENNA DIMENSIONS

Parameters	**Value (mm)**
A	24
B	9
C	27
D	15
E	9
F	10
G	2
H	2
I	3.8
J	0.2
K	25
M	12.9

The antenna was simulated using CST software. Simulation results are presented in Fig. 2. The return loss curve of Fig.2 shows that we cover two frequency bands for WLAN applications. The frequency band is from 2.3 to 2.4GHz.

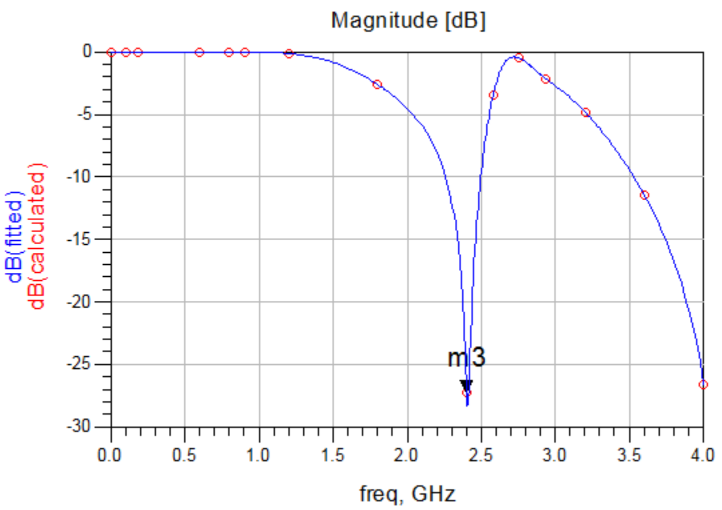
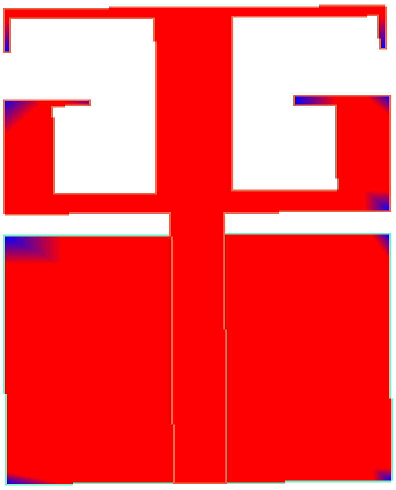


Fig. 2. Simulated return loss S11 of the double G textile antenna.

As illustrated in Table II, the gain obtained at the 2.4GHz frequency band is approximately 1.9 dB, and the directivity is 2.61 dBi.

TABLE II. REALIZED GAIN AND DIRECTIVITY

Frequency (GHz)	2.4
Realized Gain (dB)	1.9
Directivity (dBi)	2.61



2.4 Ghz

Fig. 3. Surface current distribution of the CPW double G antenna at 2.3 GHz.

Fig.3 shows the CST-simulated current distribution of the proposed antenna at frequency bands of interest 2.3 GHz. The resonance at 2.4 GHz is largely due to the inner strips of the G antenna around it resonating, while the upper strips fundamentally resonate at the upper frequency band.

III. CONLUSION

A CPW double G-shaped planar monopole antenna textile has been designed and studied. This antenna of single band type is designed to be integrated into garments. It is able to provide sufficient bandwidth impedance and radiation patterns suitable for WLAN systems. Performance in terms of return loss, realized gain and unidirectional radiation were also obtained for the operating frequencies. The performance of the integrated antenna is significantly superior to that of a microstrip patch antenna. We note that the double G textile antenna is flexible, compact size, low cost and easy to integrate into clothing for people. For future work, we will bend this textile antenna with clothes in order to see its features when the user moves. Studies are currently underway.

REFERENCES

[1] Mantash M., Tarot A. C., Collardey S., and Mahdjoubi K., "Wearablemonopole zip antenna," Electron. Lett., vol. 47, no. 23, pp. 1266–1267,Nov. 2011.G.

[2] P. Salonen, Y. Rahmat-Samii, M. Kivikoski, "Wearable antennas in the vicinity of human body," Antennas and Propagation Society International Symposium, 2004. IEEE , vol.1, pp. 467- 470, 20-25 June

[3] P. Salonen and Y. Rahmat-Samii, "Textile Antennas: Effects of Antenna Bending on Input Matching and Impedance Bandwidth," IEEE Aerospace and Electronic Systems Magazine, Vol. 22, Issue 12, pp. 18 – 22, Dec. 2007.

[4] C. Hertleer, A. Tronquo, H. Rogier, L. Vallozzi, and L. Van Langenhove, "Aperture-Coupled Patch Antenna for Integration Into Wearable Textile Systems," Antennas and Wireless Propagation Letters, IEEE, vol. 6, pp. 392-395, 2007.

[5] M. Mantash, A.-C. Tarot, S. Collardey, and K. Mahdjoubi, "Single-band CPW-fed G-Antenna using an EBG structure," Loughborough Antennas &Propagation Conference, 2012.

[6] Lanlin Zhang, Zheyu Wang and John L. Volakis, "Textile Antennas and Sensors for Body-Worn Applications," IEEE Antennas and Wireless Propagation Letters, vol. 11, pp. 1690-1693, 2012.

[7] C. Hertleer, H. Rogier, L. Vallozzi, and L. VAN Langenhove, "A texile anenna for off body communication integrated into protective clothing for fire fighters," IEEE Transactions on Antennas and Prop., vol. 57, no. 4, pp. 919–925, Apr. 2009.

[8] S. Sankaralingama, Sayantan Dhar, Bhaskar Gupta, Lotfi Osman, Kais Zeouga and Ali Gharsallah, "Performance of Electro-Textile Wearable Circular Patch Antennas in the Vicinity of Human Body at 2.45 GHz," Journal of Procedia Engineering by Elsevier, vol. 64, pp. 179-184, 2013.

[9] Raj, R. K., M. Joseph, B. Paul, and P. Mohanan, \Compact planar multiband antenna for GPS, DCS, 2.5/5.8 GHz WLAN applications," Electron. Lett., Vol. 41, No. 6, 290{291, 2005.

[10] Liu, W. C., \Broadband dual-frequency cross-shaped slot cpw-fed monopole antenna for WLAN operation," Microwave Opt. Technol. Lett., Vol. 46, No. 4, 353{355, 2005.