ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Miniature Ultra-wideband Circular Patch Antenna with Loaded Parasitic

Ch.Rajesh Babu
M.Tech Student,
Department of ECE,
QISCET,Ongole, India.

Y.V.Bhaskar Reddy
Professor,
Department of ECE,
QISCET,Ongole, India.

Abstract:

In this paper an ultra-wideband antenna for the lower frequency band is presented. The frequency band supports wireless medical applications (400-600 MHz), ISM band (2 GHz), LTE and Wi-max (2.3-3.3 GHz). Proposed antenna also cover mobile communication band 700 MHz, 900 MHz, 1600 MHz, 1700 MHz, 1800 MHz and 2100 MHz.The bandwidth of the proposed antenna is enhanced by monopole transformation and parasitic loading. For enhancing the return loss a parasitic is loaded on the top of ground. The antenna has compact size 70x50 mm2 and very simple structure. The proposed design is simulated on HFSS software.

Keywords:

Miniature Antenna; Circular patch antenna; Ultra-wideband Antenna.

I.INTRODUCTION:

Communication between humans was first by sound through voice. With the desire for slightly more distance communication came, devices such as drums, then, visual methods such as signal flags and smoke signals were used. These optical communication devices, of course, utilized the light portion of the electromagnetic spectrum. It has been only very recently in human history that the electromagnetic spectrum, outside the visible region, has been employed for communication, through the use of radio. One of humankind's greatest natural resources is the electromagnetic spectrum and the antenna has been instrumental in harnessing this resource. The development of next-generation wireless communication systems requires wideband and multiband devices for faster data transfers. Meanwhile, there is a trend toward the miniaturization of handheld devices [1]. These conflicting requirements must be met using low-cost solutions that simultaneously maintain high radiation efficiency.

Transmission-line meta-materials provide a conceptual route for implementing small resonant antennas. Typically, TL-MTM antennas suffer from narrow bandwidths. In this project, an ultra-wideband circular patch antenna is proposed with enhanced impedance matching. The proposed antenna has an ultra-wideband response and can be used in faster data rate wireless communication systems. The trend in mobile wireless devices has been to provide faster access, improved processors, more memory, brighter and higher resolution screens, additional connectivity with Wi-Fi, GPS, third generation (3G), and fourth generation (4G) world access — all with longer battery life in thinner, sleeker packages. Compound this with the desire of mobile operators to expand their available band allocations, and what results is a difficult industrial design arena, where suppliers are vying for physical space within the confines of a smartphone or similar device to accommodate the necessary components. One such component is the antenna — essentially a transducer that converts time varying with specific: Bandwidth, efficiency, size, and cost [1]. With newer Third Generation Partnership Project (3GPP) definitions for carrier aggregation, simultaneous band coverage will be also being necessary. These trends to introduce significant challenges for effective antenna design.

Many solutions have been proposed by many researchers. In ref. [2] design and Analysis of a Low-Profile and Broadband Micro-strip Monopole Patch antenna is presented. The proposed antenna has a wideband response but a complex design structure. The antenna has a wide bandwidth and a monopole-like radiation pattern. Such antenna is constructed on a circular patch antenna that is shorted concentrically with a set of conductive via. Wideband Dual-Polarization Micro-strip Patch Antenna Array for Airborne Ice Sounder [3], structure of the antenna is very complicated and suffers poor bandwidth and larger size. The antenna array of four elements did not show any compromise in bandwidth. It exhibited side-lobe levels better than 15 dB, with a gain of around 12 dBi.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Excellent agreement was achieved between measurements and predictions for the designs of both the single element and the array. This antenna is part of the European Space Agency's airborne polar metric P-band terrestrial ice sounder. Wideband High Directive Aperture Coupled Micro-strip antenna Design by Using a FSS Superstrate Layer [4], SISO antenna is designed and aperture coupling feed is used. The feeding mechanism is complex which will yield in the costlier antenna. High directive electromagnetic band-gap (EBG) antenna operating in the wide frequency band for both return loss (RL) and directivity is examined. In this EBG antenna, an aperture coupled micro-strip antenna (ACMA) is used as a feeding source and a frequency selective surface (FSS) is used as a superstrate layer. Suitable use of the superstrate layer, micro-strip patch and coupling aperture simultaneously, leads to produce separate resonance frequencies and, therefore, the wide frequency band for RL. A Printed Wide-Slot Antenna with a modified L-Shaped Micro-strip line for Wideband Applications [5], the proposed antenna is much larger in the size of 80x54 mm2. Such a larger antenna is not useful for compact mobile devices. Most of the proposed wideband antenna in literature is larger in size and not suitable for the compact devices. Wideband antennas are presented in the literature [6]-[14] have either complex feeding mechanism or complex structure. In the paper, an ultra-wideband antenna is proposed with compact size, simple structure, and co-planer feeding mechanism. Co-planer feeding mechanism makes integration of antenna with printed board very simple.

II.ANTENNA DESIGN AND STRUCTURE:

The conventional patch antenna is designed using the following equations [14]:

$$f_{nm} = \frac{X_{nm}c}{2\pi a_e\sqrt{\varepsilon r}} \quad (2.1)$$

Table.1

Values of x_{nm} for different propagation modes

Modes(n,m)	0,1	1,1	2,1	0,2	3,1
x_{nm}	0	1.84	3.05	3.83	4.20

$$a_e = a[1+\frac{2h}{\pi a\varepsilon r}\{\ln\frac{\pi a}{2h} + 1.7726\}]1/2 \quad (2.2)$$

$$Lg \leq a+6h \quad (2.3)$$

$$Wg \leq a+6h \quad (2.4)$$

For TM_{11} mode the input resistance at resonance can be expressed as:

$$Rin = RrCos2\ (\pi yfL) \quad (2.5)$$

$$yf = \frac{L}{2\sqrt{\varepsilon ref(L)}} \quad (2.6)$$

$$xf = W/2 \quad (2.7)$$

FR4 Epoxy dielectric material is used with dielectric constant 4.4 and thickness h=1.6mm. The calculated dimensions of the antenna are depicted in the figure. Compact circular patch antennas are depicted in Figure 1. To achieve the compact size conventional dipole micro-strip antenna is transformed into a monopole antenna. The ground plane of the dipole antenna is removed to transform it to a monopole antenna.

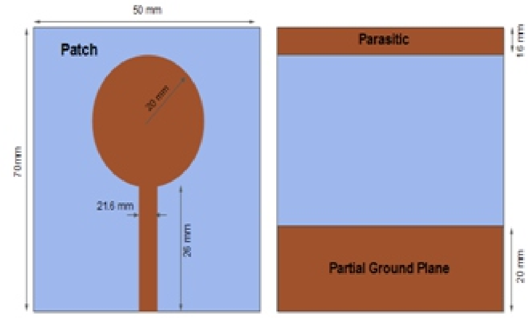


Figure 1 Configuration of proposed antenna.

III.RESULTS AND DISCUSSION:

The return loss of ultra-wideband is below -10 dB 550 MHz to 3.28 GHz bands and the VSWR of the antenna is improved than the conventional circular patch antenna. The input impedance of the antenna is nearly 50 Ohm in the entire operating band. The radiation pattern of a monopole antenna is omnidirectional and this can be observed in Figure 5 (a) and (b).A partial ground plane is loaded at the feeding point to introduce additional reactance which results in ultra-wideband response. The partial ground plane introduces a parallel capacitive reactance in the monopole configuration antenna which results in second resonant frequency and hence the bandwidth of the antenna is enhanced. The results of the ultra-wideband circular patch antenna are depicted in Figure2 to Figure 7.For improving the impedance matching a parasitic is loaded on the top of the ground plane.Due to the loaded parasitic impedance matching of antenna with 50 Ohm micro-strip feeding line is improved. This improved impedance matching also results in enhancing the bandwidth of the antenna.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

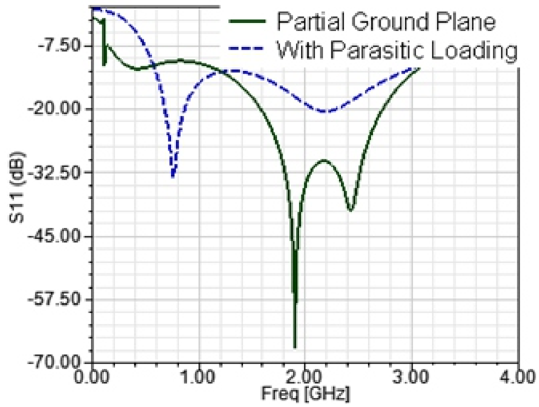


Figure 2 Return Loss

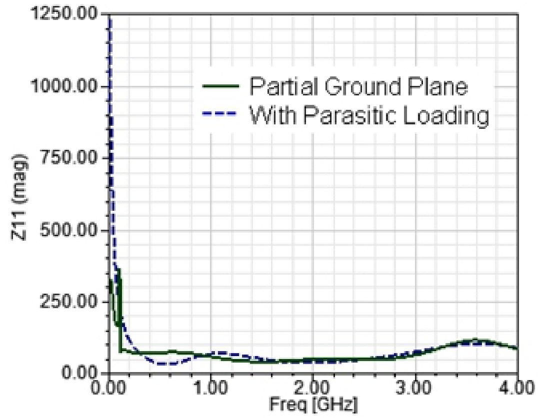


Figure 3 Input Impedance

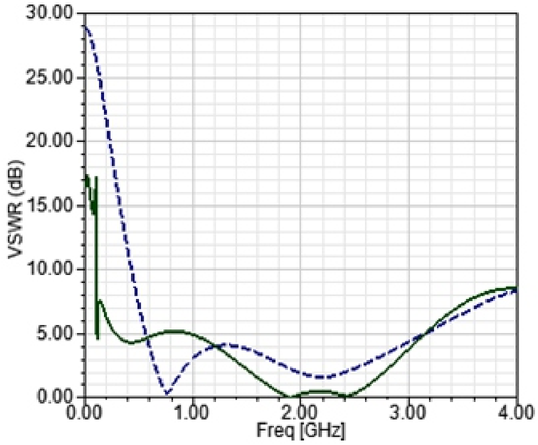
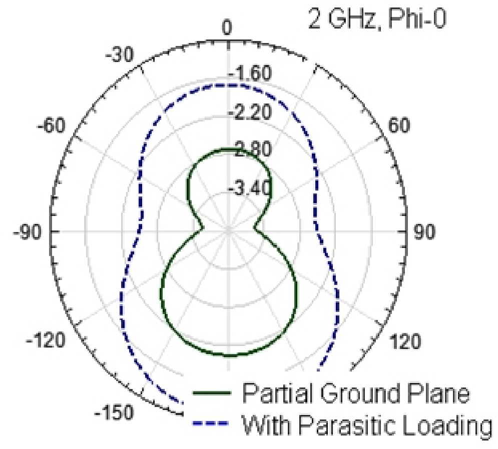
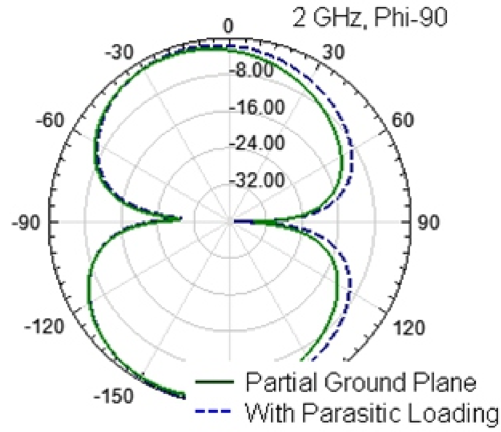


Figure 4 VSWR



(a)



(b)

Figure 5 Radiation Pattern.

IV. CONCLUSION:

An ultra-wideband circular patch antenna is presented which covers most applicable frequency band 400 MHz to 3.2 GHz. Different configurations conventional, monopole, partial ground and partial ground with parasitic loading are studied and analyzed. The proposed antenna has a very simple structure and compact size (35 cm2) which will make the fabrication and integration process very easy.

The antenna exhibits omnidirectional radiation pattern and suitable for wireless devices. The input impedance of the antenna is nearly 50 ohm for the entire band and VSWR is an acceptable range. However, the simulated antenna needs to be tested in the practical implementation.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

V. REFERENCES:

[1] Frank M. Caimi, "Antenna Design Challenges for 4G," IEEE Wireless Communications, December 2011.

[2] Juhua Liu, QuanXue, HangWong, HauWah Lai, and Yunliang Long, "Design and Analysis of a Low-Profile and Broadband MicrostripMonopolar Patch Antenna," IEEE Transactions on Antennas and Propagation, Vol. 61, No. 1, January 2013

[3] Jose Luis Vazquez-Roy, Viktor Krozer and Jørgen-Dall, "Wideband Dual-Polarization Microstrip Patch Antenna Array for Airborne Ice Sounder," IEEE Antennas and Propagation Magazine, Vol. 54, No. 4, August 2012

[4] Abbas Pirhadi, HadiBahrami, and JavadNasri, "Wideband High Directive Aperture Coupled Microstrip Antenna Design by Using a FSS Superstrate Layer," IEEE Transactions on Antennas And Propagation, Vol. 60, No. 4, April 2012

[5] Y. Sung, "A Printed Wide-Slot Antenna with a Modified L-Shaped Microstrip Line for Wideband Applications," IEEE Transactions on Antennas and Propagation, Vol. 59, No. 10, October 2011

[6] Dan Sun and Lizhi You, "A Broadband Impedance Matching Method for Proximity-Coupled Microstrip Antenna," IEEE Transactions On Antennas And Propagation, Vol. 58, No. 4, April 2010

[7] Dan Sun, Wenbin Dou, Lizhi You, Xuequan Yan, and RongShen, "A Broadband Proximity-Coupled Stacked Microstrip Antenna With Cavity-Backed Configuration," IEEE Antennas And Wireless Propagation Letters, Vol. 10, 2011

[8] V. P. Sarin, M. S. Nishamol, D. Tony, C. K. Aanandan, P. Mohanan, and K. Vasudevan, "A Broadband -Strip Fed Printed Microstrip Antenna," IEEE Transactions On Antennas And Propagation, Vol. 59, No. 1, January 2011

[9] AbolfazlAzari, "A New Super Wideband Fractal Microstrip Antenna," IEEE Transactions on Antennas and Propagation, Vol. 59, No. 5, May 2011

[10] Xing Chen, Guosheng Wang, and Kama Huang, "A Novel Wideband and Compact Microstrip Grid Array Antenna," IEEE Transactions On Antennas And Propagation, Vol. 58, No. 2, February 2010.

[11] Qi Wu, Ronghong Jin, and JunpingGeng, "A Single-Layer UltrawidebandMicrostrip Antenna," IEEE Transactions on Antennas And Propagation, Vol. 58, No. 1, January 2010.

[12] Xue Ni Low, ZhiNing Chen, and Terence S. P. See, "A UWB Dipole Antenna With Enhanced Impedance and Gain Performance," IEEE Transactions On Antennas And Propagation, Vol. 57, No. 10, October 2009.

[13] Christopher J. Meagher, and Satish Kumar Sharma, "A Wideband Aperture-Coupled Microstrip Patch Antenna Employing Spaced Dielectric Cover for Enhanced Gain Performance," IEEE Transactions On Antennas And Propagation, Vol. 58, No. 9, September 2010.

[14] R. Garg, P. Bhartia, I. Bahl, A. Ittipiboon, Microstrip Antenna Design Handbook, Artec House, Boston 2001.

[15] C. A. Balanis, Antenna Theory, Analysis and Design, Jhon Wiley & Sons, INC Newyork 1997.