Abstract

The proposed planar antenna with different asymmetrically hanging type arms for WLAN/Bluetooth/Zigbee/WiMAX/HYPERLAN and Military applications. The proposed antenna consists asymmetrically three arms and defected ground plane to resonates 2.44GHz, 3.4GHz 5.3GHz and 7.5GHz cover WLAN, Bluetooth, Zigbee, WiMAX, HYPERLAN and Military applications. The dimension of antenna is 32×12×1.6mm³. The fabricated antenna shows good measured results for the multiband operation as per simulated.

Key Words: ARM., Zigbee, WiMAX, WLAN, HYPERLAN, Bluetooth, Military and Multiband

1. Introduction

Recently multiband planar monopole antenna became very popular due to small size, low weight, portable and easily comfortable with electronic circuits. Now a days portable devices consists of different frequency bands for wireless local area network (WLAN) standards in the 2.4GHz(2400–2480 MHz), 5.2GHz(5150-5350MHz) 5.8GHz (5725-5825MHz), Zigbee (2.405- 2.480GHz), WiMAX3.5GHz (3400-3600MHz) Bluetooth (2400-2483.5MHz) and military(7250-7750). The multiband antenna becomes popular instead of using single band for single antenna which reduces size as well as applicable of different band in several portable advance devices such as laptop, cellular phone sets and stylish phones is also growing such type of provision. The internet and mobile communication needs the enlargement of microwave systems such as WLANs, Bluetooth, Zigbee and WiMAX beside with elevated speed release data at reasonable price.

There are various techniques available for designing multiband planar monopole antenna. A multiple band obtained by few researcher are as follows, three rectangular tuning strips is used to cover the desired bands [1]. The two F-shaped slots of the same size are etched on a rectangular patch to achieve multiband operation[2]. The inverted U-shaped and L-shaped strip provide the wideband nature to cover the WLAN with WiMAX frequency band [3]. The symmetrical L- and U-shaped slots were cut out within patch to provide desired resonance frequencies [4]. The proposed antenna consists of an F-shaped with an inverted L-shaped strip-sleeve shorted at the ground plane [5]. The projected antenna consists of U and T shaped stub resonator to obtained dual band [6]. It consists two symmetrical twisted arms with each arm two bended strips with same width and lengths and partial ground plane [7]. U-shape get by connecting two short line and added two square shapes at the upper side of each line which they give good response at two operating frequencies 2.4 GHz and 3.5 GHz [8]. In this antenna was added U shaped branch which resonates at the lowest frequency of 900 MHz Similarly other L shaped branches were added to achieve resonance at other desired frequencies[9]. There are two L-shaped slots scratch out of the ground and one U-shaped slot out of the E-shaped patch[10]. The L-shaped slot cut out of the ground and patch, is produced multiband operation [11].

The gain of different planar monopole antennas have enough but their advantages such as easy fabrication, compact size, multiple band, low size, low weight and easy fabrication etc. The plan behind this designing is to developed planar monopole antenna at a reasonable price, which can work WLAN, WiMAX, HYPERLAN, Zigbee and Bluetooth applications. It can be mentioned here that job involves in depth parametric study, which would assist the upcoming designers to select any parameter of the antenna depending upon the needs for obtain the result. Here, a low profile multiband planar monopole antenna is presented which covers WLAN, WiMAX, HYPERLAN, Bluetooth and Zigbee frequency bands. The projected antenna is low profile such as easy fabrication, compact size, multiple band, low size, low weight and easy fabrication etc. The antennas belong with asymmetrically arms and modified ground plane to achieve multiband.
2. Antenna design with simulation result

Figure 1, shows the real physical construction of the antenna with back side and front side using Computer Simulation Technology (CST software) Microwave studio. The FR4 substrate is used with relative dielectric constant 4.3 and height 1.6 mm. The in particular volume of antenna is 32x12x1.6 mm3. The parametric analysis is optimized for good impedance matching and to generate for multiple band operation. When the matching of impedance with source through SMA connector and antenna to deliver more amount of power at output side. In multiband antenna capacitor and inductor are responsible for generate complex network due to the frequency dependent component which some quality factor.

Table 1 shows dimensions of patch and ground of proposed antenna. The microstrip line is connected to the patch of front side of antenna which is taken as 2mm to produce 50 for resonant frequency so, the radiating patch and microstrip line is on same side.

3. Simulation results

The entire simulations of the projected antenna are carried out with the Computer Simulation Technology (CST software) Microwave studio. The simulated reflection coefficient is offered in fig.2. From the figure 2 it is observed that arm2 is produced resonant frequencies like 2.44GHz, 3.4GHz. The arm1 is responsible for 5.29GHz. The arm3 is responsible for 57.54GHz. Modified ground plane improve the bandwidth with matching input impedance for generating different resonant frequencies. The inferior frequency band is from 2.39 to 2.51 GHz with bandwidth of 120MHz casing Zigbee, Bluetooth and WLAN.

From figure 2 it is observed that the reflection coefficient for useful resonance frequency is less than -10dB so it is acceptable by comparing standard parameter.

It is radiated more than 90% power when the VSWR changes from 1 to 2. For every resonance frequency VSWR lies between 1 & 2 such as 1.07 for 2.44GHz, 1.29 for 3.4GHz, 1.102 for 5.28GHz & 1.0531 for 7.52 GHz. The VSWR is directly correlated with matching of transmission. When VSWR is closed to one mean the more power is radiated from antenna.
Its E-field far plot is given in Figure 4. The basic patch covered with omnidirectional because side lobe level is small. The orientation of patch play important role that whether antenna is suitable for cellular devices or not so proposed planar antenna shows vertical or horizontal polarization. The polar type radiation patterns of the antenna and gain at different frequencies are shown in Figure 4. The simulated gain for 2.44GHz, 3.4GHz, 5.29GHz, and 7.53GHz resonance frequencies is 1.28 dB, 1.94 dB, 0.15 dB, and 3.14 dB respectively.

4. Experimental Results

This proposed antenna is fabricated using PCB Prototype machine which results are tested by Vector Network Analyser (VNA). The VNA is calibrated by calibration trainer kit which minimizes the error due and connectors. The photo of fabricated multiband planar monopole is as shown in below figure 6.

In figure 6 shows the fabricated front side of patch antenna with all necessary dimensions including SMA connector. Bottom side of patch antenna shows in figure 6 with all corresponding simulation dimensions by SMA connector soldering.
above figure shows that proposed antenna is suitable for the multiband operation. The measured and simulated results of S11 quite match by comparing to each other. From the above analysis it is clear that most of electromagnetic waves radiates to the outward direction. From the above observation it is conclude that antenna deliver more than 90% power to the surrounding areas.

4. Conclusions

In this paper design and analysis of different arms to obtained different resonance frequencies. Both fabricated and simulated results has quite same by measuring Vector Network Analyser. For different resonating frequencies like 2.44GHz, 3.4GHz and 5.29GHz which has low return loss. The fabrication antenna can be used for various applications such as WLAN, Bluetooth, Zigbee, WiMAX and HYPERLAN. It provides good for wireless applications to different frequency. By using arm structure technique reduce the size of antenna maintaining the all important parameters.

References

[1] Lierong Wu, Jingjian Huang, and Naichang Yuan "Compact Multiband Monopole Antenna for GPS/WLAN/ WiMAX Application "IEEE ICMMT, Vol.2, pp. 618-620, 2016.
[2] Lalit Kumar and Anil kumar Gautam "Design of F-shaped slot Triple Band Antenna for WLAN/ WiMAX Applications "IEEE Transactions and wave propagation ,Vol.64, pp. 1101-1105,2015.
[3] Sachin Kalraiyia, Hari Shankar Singh, Manoj Kumar Meshram and M. Thottapan “Microstrip-line-Fed Dual Band Printed Monopole Antenna for WLAN/ WiMAX/ HIPERLAN Applications” IEEE, pp.224-227, 2014.
[4] Mahdi Moosazadeh and Sergey Kharkovsky “Compact and Small Planar Monopole Antenna With Symmetrical L- and U-Shaped Slots for WLAN/ WiMAX Applications" Antennas and Wireless Propagation Letters, IEEE, Vol.13, pp. 388-391, 2014.
[5] Chong-Wei Liou and Jui-Han Lu “ Planar F-shaped monopole antenna with dual-band circular polarization for WLAN systems, Electromagnetics, IEEE, pp.149-150, 2014.
[6] Rupali Kachare, Shankar Deosarkar and Vikas Deshmukh “Compact Dual Band Planar Monopole Antenna for WLAN/ WiMAX” Communications and Signal Processing, IEEE, pp.391-394, 2014.
[7] S. Venkatram Reddy, Aditya Singh, Yadu Nath. K and M. Jaleel Akhtar “Design of a Practical Dual-band Planar Monopole Antenna for WLAN and WiMAX Applications” Communications ,IEEE, pp.1-5, 2013.
[8] Khalid Ali Sultan Jasim and Y. E. Mohammed Ali " Compact dual-band Monopole Antenna for WLAN/ WiMAX Applications" IEEE, pp.1-3, 2013.
[9] Qi-Tao Zhang, Y. C. Jiao and Y. Ding “Design of a Planar Multiband Antenna with U- and L-shaped slots"Microwave Technology & Computational Electromagnetics, IEEE, pp.331-334, 2011.
[10] Qi-Tao Zhang, Y. C. Jiao and Y. Ding "Design of a Planar Multiband Antenna with U- and L-shaped slots"Microwave Technology & Computational Electromagnetics,IEEE, pp.331-334, 2011.
[11] Yang Ding, Y. C. Jiao, R. Zou, B. Li, Q. T. Zhang "Design of a Narrow-Size Planar Monopole Multiband Antenna with Double L-shaped Slots"Cross Strait Quad-Regional Radio Science and Wireless Technology Conference, IEEE, Vol.1, pp.455-458, 2011.