A STUDY OF BANDWIDTH ENHANCEMENT OF DUAL-BAND MONOPOLE ANTENNA WITH STAGGER-TUNES ARMS

B.Ambika Sree[1], B.Meena[2]

[1,2]Assistant Professor, ECE Department, Sphoorthy Engineering College,
Hyderabad, Telangana (India)

ABSTRACT

This paper focus on a dual-band miniaturized printed monopole for integration in modern wireless systems. The printed monopole is augmented with two arms, resonant at slightly different frequencies provides a broadened response for the upper band. The bandwidth is achieved for the high band is 36%. The antennas proposed here are for the emerging dual-mode multi-band WLAN transceivers, operate over a wide range of bands as dictated by national authorities. The numerical method employed was the finite integration technique. Measured and simulated data including return loss, antenna gain and radiation patterns are presented.

Keywords*: *Monopole Antenna, Dual – Band radiation patterns, WLAN transceivers and Finite integration technique.

I. INTRODUCTION

The frequencies employed by WLAN systems in the US are covered by Dual band monopoles [1]. Two branch monopoles have been employed in printed form but do not have sufficient bandwidth for the high band. These provide about 700-800 MHz which is slightly narrow and may be prone to tolerance problems, when low cost substrates are used. FR4 is commonly used because of its low cost, but this substrate suffers badly with lack of stability of permittivity and loss tangent with frequency [2].

Many innovative wireless systems are currently developing in frequency bands that have been set aside by national authorities for license free use. The two key bands in Europe being the 2.4 to 2.5 GHz ISM band and 5.15 to 5.88 GHz bands. The 5GHz bands consist of frequencies assigned for license free use between 5.15 and 5.35GHz and between 5.47 and 5.88 GHz, with 5.73 to 5.88 GHz allocated for ISM use. The US bands are slightly different, but not extending outside the European bands. In Japan, 4.9 - 5.0 GHz and 5.03 - 5.091 GHz are used for the upper band.

Dual-mode multiband WLAN transceivers must now operate across all these bands. The antenna bandwidth demanded to cover all these systems is 100 MHz in the low band (2.4-2.5 GHz) and 980 MHz in the upper band (4.9-5.88 GHz) [3].

II. ANTENNA GEOMETRY

The antenna geometry and coordinate system is shown in Figure 1. The dimensions of the antenna are h1 =23.5 mm, h2 =4.3 mm, h3 =2.5mm, h4 =4mm, w1 =5.9 mm, w2 =5.3mm. The substrate dimensions are *l*=80 mm and *W*=60 mm with the ground plane extending 28 mm from the bottom edge. The monopole is printed on one side of the substrate and fed by a micro strip feed line of width *w*=2.3 mm. The feed line is excited by an SMA launch connector. The ground plane is located at the other side of the laminate as shown. The board thickness is 1.52 mm and the metallization thickness is 35 microns (1 oz./sq.ft). The relative permittivity and loss tangent are 4.3 and 0.02, respectively at 2 GHz.

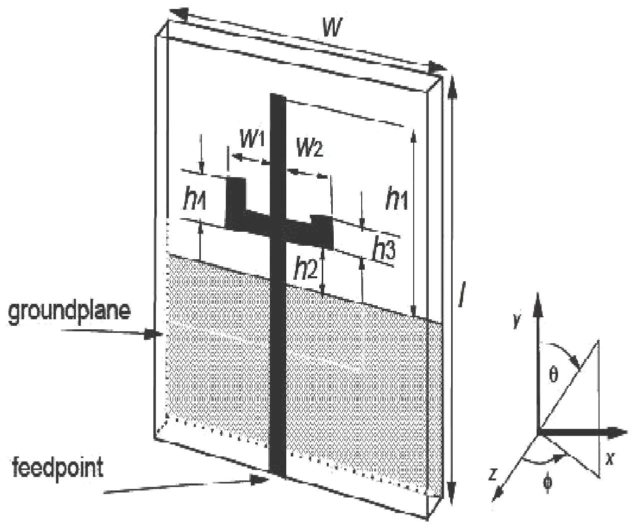

Fig.1. Geometry of the microstrip-fed dual band printed monopole with stagger tuned arms for upper band.

III. MEASURMENTS AND SIMULATION

In Figure 2, the measured return loss was greater than 10 dB from 2.15–2.75 GHz and from 4.55–5.91 GHz.
The resonances for each of the monopole arms were found using this technique and were 4.8 GHz and 5.5 GHz for the long and short arms respectively.
The simulated response, carried out using finite integration [4][6], is in reasonable agreement.

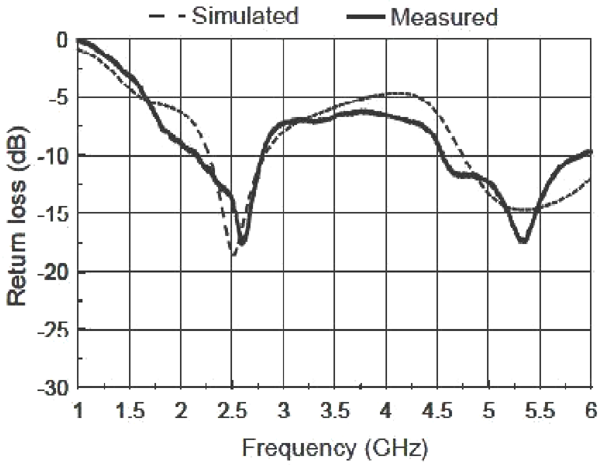

Fig.2. Measured and simulated return loss for the dual-band printed antenna.

IV. RADIATION PATTERNS

In Figure 4, the measured radiation patterns are normalized to maximum gain. Numerical analysis determined the radiation efficiency to be 80 % and 76 %. The maximum gain was found to be 3.1 dBi and 2.8 dBi at 2.45 and 5 GHz respectively. The reduction in maximum gain by using this low-cost laminate compared to low-loss laminate is about 0.8 dB (2.5 GHz) and 1.4 dB (5.2 GHz), but the increased substrate losses contribute significantly to the enhanced bandwidth [5].

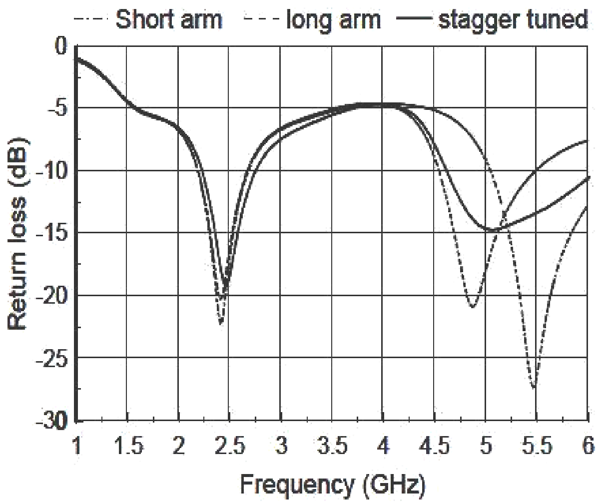

Fig.3. Simulated return loss for the monopole with (a) short arm, (b) long arm and (c) both arms stagger tuned.

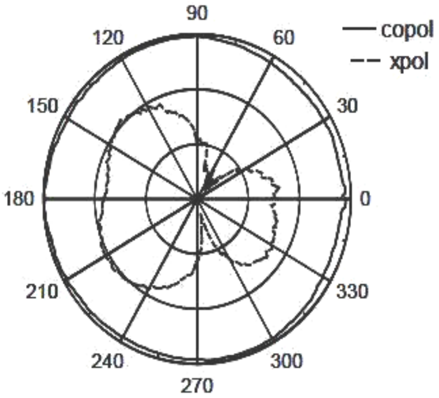

Fig.4 (a).Radiation pattern for the Ø, ɵ = 0(XZ) plane at 2.5GHZ.

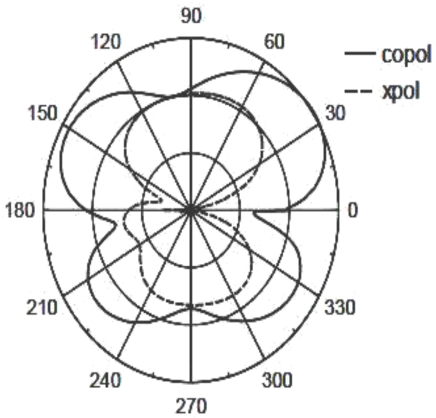

Fig.4 (b).Radiation pattern for the Ø, ɵ = 0(XZ) plane at 5.2GHZ.

V CONCLUSION

By adding stagger-tuned arms to the printed monopole, Dual-band printed monopoles with enhanced bandwidth are achieved. For the upper band more than 35% fractional impedance bandwidth is obtained which is sufficient to cover all wireless bands as dictated by different national authorities.

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