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A COMPACT G-SHAPED DUAL-BAND ANTENNA FOR WLAN/WI-MAX AND RFID APPLICATIONS

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ABSTRACT
In this paper a G-shaped dual-band monopole antenna with a shorted strip fed by a coupling microstrip line for wireless communication in the wireless local-area network (WLAN) band is studied. The proposed antenna can provide two separate impedance bandwidths of 510MHz (2.29GHz-2.8GHz) and 1.9GHz (4.73GHz-6.65GHz) respectively. Consistent omniderectional radiation patterns have been observed in both the frequency bands 2.4GHz and 5.5GHz. The proposed antenna is simple in design and compact in size. It exhibits broadband impedance matching, consistent omnidirectional patterns and appropriate gain characteristics (>2.8dBi) in the RFID and WLAN/Wi-MAX frequency regions.

KEYWORDS: Dual band antenna, Wireless applications, WLAN, Wi-MAX, RFID,CST Microwave Studio.

INTRODUCTION
With the increase of demand for data usage, internet connectivity and networking, new methods have emerged out making older methods obsolete. Notable structures among them are: CPW-fed dual frequency monopole antenna [1], dual band CPW-fed strip-sleeve monopole antenna [2], CPW fed L-shaped slot planar monopole antenna for triple band operation [3], internal planar monopole for mobile phones [4], dual-band planar branched monopole antenna [5], dual band U-slot antenna[6], etc. Similarly, many compact antennas for RFID application at 5800 MHz are available in the literature such as CPW-fed folded slot [7], T-shaped folded slot monopole antenna [8], F-shaped CPW-fed monopole antenna [9], CPW-fed dual folded strip [10], semi circular CPW fed folded slot antenna [11] etc. Our intension is here to design a compact monopole antenna, which can be used simultaneously for WLAN as well as RFID systems. One such emerging technology that we are going to focus here is Wi-MAX, a wireless communication standard (IEEE 802.16 family of network standards [12], designed to provide a data rate of 30-270Mbps [13]. There is no uniform global licensed spectrum for Wi-MAX, however the Wi-MAX forum has published there licensed spectrum profiles: 2.3GHz, 2.5GHz and 3.5GHz, in an effort to drive standardization and decrease cost.
In this paper, a simple and compact G-shaped antenna with a shorted strip fed by a coupling microstrip line feed antenna is presented, and discussed for RFID and WLAN/Wi-MAX. The proposed antenna exhibit dual band characteristics with the lower resonant band of (2.29-2.8GHz) and the upper band of (4.73-6.65GHz). These bands are suitable to cover the industrial Scientific Medical (ISM 2.4-2.484GHZ), Radio Frequency Identification (RFID 2.45GHz), Wireless Local Area Network (WLAN 2.4-2.484GHz), and Wi-MAX (5.2-5.8GHz)

MATERIALS AND METHODS
This proposed antenna is printed on an FR4 substrate with size of 30×38×1.6mm3, including substrate thickness of 1.6mm, and dielectric constant of 4.4 with 0.02 loss tangent. The width of the micro-strip feed line W_f = 3.06 mm to achieve 50Ω characteristic impedance. The dimension for ground plane is (W × l_g). On the front surface of the substrate, a modified rectangular patch viz. G-shaped is printed. By this G-shaped structure it is found that much enhanced impedance bandwidth can be achieved for proposed antenna. In addition good wideband matching of the proposed antenna, finite ground plane structure is designed.

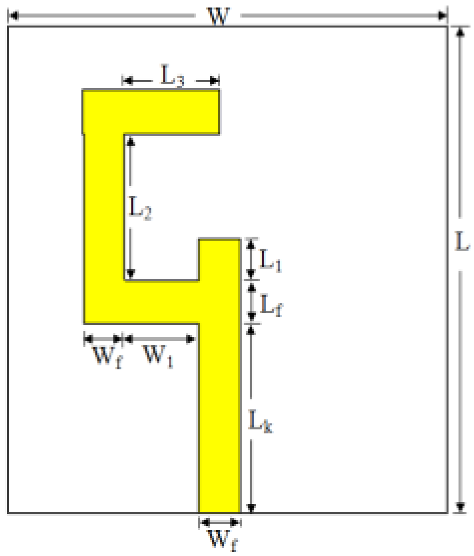

Fig.1. Top view of antenna

The dimensions and specification of the proposed antenna are as follows. Refer fig. 1.

Table 1: Parameters and Values of Dual-Band Antenna

L_1	2.9
L_2	5.4
L_f	3
L_k	13
H	1.6
L	38
L_3	10
L_4	7
L_g	12
T	0.035
W	30
W_f	3.06

ANALYSIS

The proposed G-shaped dual–band antenna has been designed to resonate with the lower frequency is located at 2.5GHz. After optimizing the different antenna parameters, the proper design has been chosen to get the required results with the dual-band characteristics.

The antenna is fed by a microstrip center lined technique. The radiator and ground plane are on the two opposite faces of flame retarding (FR4) substrate having thickness of 1.6mm with relative permittivity and loss tangent 4.4 and 0.02 respectively.

RESULTS AND DISCUSSION

The simulated return loss of presented structure is shown in fig 2. Two resonant peaks achieved at 2.5GHz and 5.5GHz demonstrate that the antenna is showing a dual–band character. The bandwidth defined for -10dB return loss is about 510MHz and 1.92GHz at 2.4GHz and 5.5GHz respectively. In fact, the achieved bandwidths of all together cover WLAN standards in the 2.4/5.2/5.8 GHz bands, Bluetooth standard in the 2.4GHz band, and Wi-MAX and RFID standard in the 5.5GHz band. The radiation pattern of the proposed antenna that shows both the E and H-planes patterns for 2.5GHz frequency is represented in fig.3 and for 5.5GHz in fig.4. Smith chart pattern for proposed antenna is represented in fig.5. With G-shaped a dual band characteristic was obtained. This signifies that with G-shaped two resonances were excited and the sides cut considerably improved the matching conditions for lowest (2.071-2.998GHz) and highest (5.1760-5.8639GHz) bands. To further examine the excitation mechanism, average surface current distributions obtained from CST simulation on patches and ground plane for optimized antenna were studied.

A large surface current was observed over the patch and along the microstrip line at both the resonant frequencies. At lower frequency the current was more concentrated along one of the parallel arms of G-shaped which displays current distribution on ground at 2.5GHz and 5.52GHz, whereas at higher frequency current was more distributed along the periphery of other arm of G-shaped. The effect of various dimensions of G-shape on return loss was also examined.

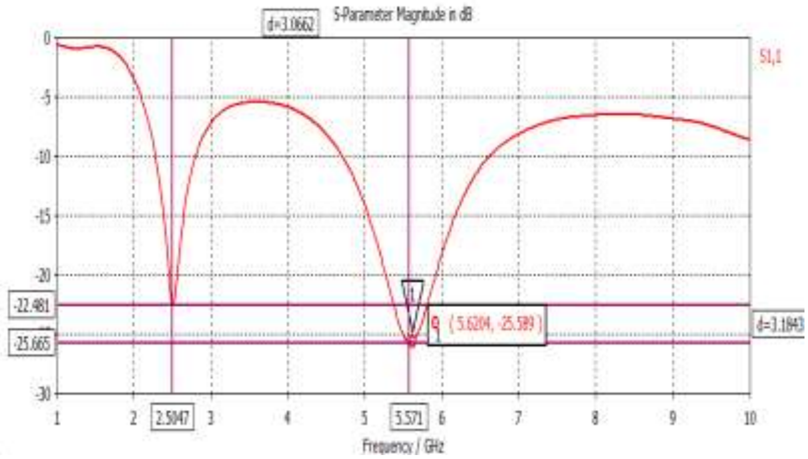

Fig. 2 Simulated Return loss (dB against Frequency for Proposed Antenna with G-shaped and with no defect)

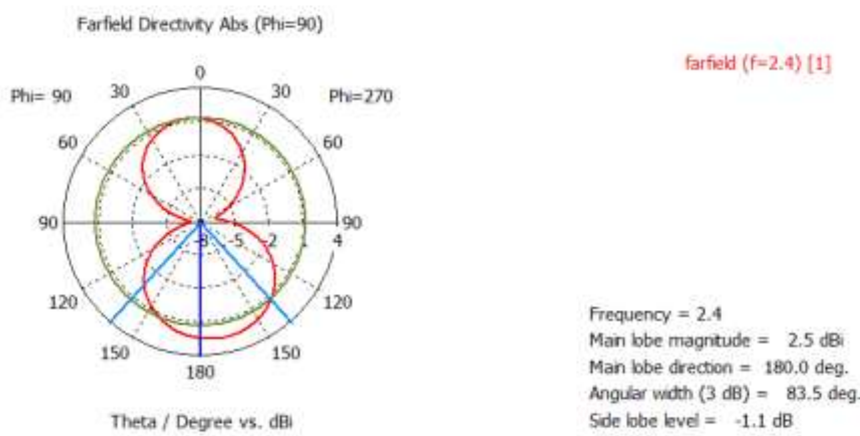

Fig. 3 Simulated Radiation Pattern for proposed Antenna at 2.4 GHz frequency

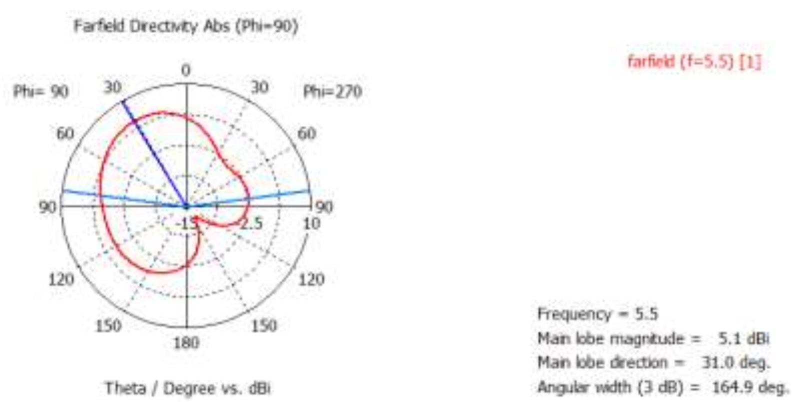

Fig. 4 Simulated Radiation Pattern for proposed Antenna at 5.52 GHz frequency

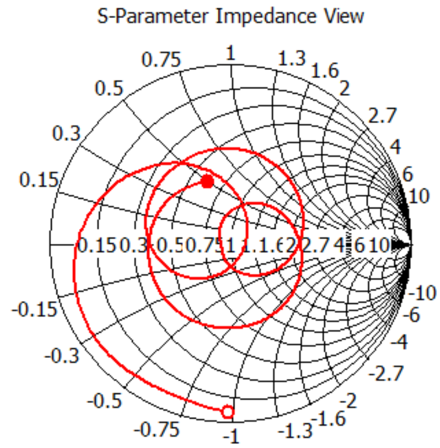

Fig. 5 Smith chart for proposed Antenna

CONCLUSION

A compact G-shaped microstrip feed antenna producing dual resonance frequencies with enhanced frequency diversity. Satisfactory dual-band operations for WLAN/Wi-MAX and RFID applications are easily achieved by the G-shaped configuration. The proposed antenna is simple to design and compact in size. It provides broadband impedance matching, consistent radiation pattern appropriate gain characteristics in the RFID and WLAN/Wi-MAX frequency range.

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