VOL. 10, NO. 1, JANUARY 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

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NOVEL DESIGN BROADBAND CPW-FED MONOPOLE ANTENNA WITH TRAPEZIUM SHAPED-STUB FOR COMMUNICATION SYSTEM

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ABSTRACT

A broadband coplanar waveguide CPW-fed planar monopole antenna for S_{11}< -10dB, wireless applications is presented in this paper. The designed microstrip patch antenna as trapezium-shaped is used to improve the bandwidth with theta = 40°degree.the antenna covers the 5.2 / 5.8 and 5.5 GHz WLAN and WiMaX applications at impedance bandwidth 1641.4MHz (4.8483-6.4897) GHz, VSWR< 2 and stable radiation patterns.

Keywords: broadband CPW-fed, monopole antenna, trapezium shaped, WLAN and WiMaX application.

1. INTRODUCTION

The design of broadband antennas has received the attention of many antenna researchers due to their various applications. The requirements include abroad impedance bandwidth, omnidirection patterns, constant gain and low pulse distortion [1-2]. Planar monopole antenna is able to radiate bi-directional radiation patterns with larger bandwidths. Coplanar waveguide (CPW) feeding is supposed to be better candidates because of their simple configuration, manufacturing advantages, and low cost. CPW-fed slot antennas have been studied extensively [3-4]. One method is to use different shapes of tuning stubs to achieve wideband performance; other methods use different slot shape, such as square, rectangular and ring slots with appropriate turning stub. The CPW fed planar slot antennas have the advantages of wide bandwidth, low cost and easy to integration with radio frequency [5-6]. in general planar slot antennas two parameters affect the impedance bandwidth of the antenna, the slot width and feed structure [7]. The wider slot gives more bandwidth and the feed structure gives the good impedance matching in this paper, a CPW-fed novel planar broadband monopole trapezium microstrip antenna is presented. In order to obtain broadband, some modifications about the antenna are introduced. Simply by cut in the radiating and top edge element also to make like trapezium-shaped patch, to improve the bandwidth. The antenna consists of novel patch in a wide rectangular slot and it is fed by coplanar wave guide (CPW). The simulated VSWR and stable radiation pattern are presented for the antenna.

2. Broadband antenna design

The rectangular patch antenna has a narrow-band characteristic. To improve its operating bandwidth, we shape the rectangular patch in to an trapezium with theta= 40°degree for various values of (theta) degrees are studied and found that when theta= 40°degree give good responses. Since it has gives good bandwidth. The proposed antenna is fed by a 50 ohm CPW-fed. the final geometry of the proposed antenna is depicted in Figure-2 is printed on a FR4 substrate with size L_p x W_p, 26mm x19mm, thickness h of 1.6 mm, a dielectric constant of 4.4, and loss tangent δ = 0.025 the center strip and gap of the CPW line are 2.398mm and 0.53mm to achieve 50 ohm port characteristic. The final antenna geometry parameters are obtained as w_1=2.1mm, L_1=5.7mm, L_2=7.4mm, L_3=7.771mm, L_4=7.45mm, L_5=5.15mm, w_f =2.398mm, L_f =7.7mm,
S= 0.53mm, theta= 40°degree, h=1.6mm, the far electric fields of the trapezium patch are as follows. [8].

$$E_\theta = \frac{Ke^{-jor}}{r}\cos\left(k_0 h\sqrt{\varepsilon_r}\cos\theta\right)\frac{\sin\left(\frac{\pi W}{\lambda_0}Sin\,\theta Sin\,\varphi\right)Cos\left(\frac{\pi L}{\lambda_0}Sin\,\theta\cos\varphi\right)\cos\varphi}{Sin\,\theta Sin\,\varphi} \quad \text{.................. (1)}$$

$$E_\varphi = \frac{-Ke^{-jkr_0}}{r}Cos\left(k_0 h\sqrt{\varepsilon_r}Cos\,\theta\right)\frac{\sin\left(\frac{\pi W}{\lambda_0}Sin\,\theta Sin\,\varphi\right)Cos\left(\frac{\pi L}{\lambda_0}Sin\,\theta\cos\varphi\right)\cos\varphi}{Sin\,\theta Sin\,\varphi} \quad \text{......(2)}$$

Equation (1 and 2) enables one to plot the radiation pattern for every mode of the trapezium microstrip patch antenna. the width and length of the patch are given at [9-10]

$$W = \frac{c}{2f_o\sqrt{\frac{\varepsilon_r+1}{2}}} \quad (3)$$

$$L = L_{eff} - 2\Delta L \quad (4)$$

$$\varepsilon_{eff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\sqrt{\frac{1}{\left[1+12\frac{h}{w}\right]}} \quad (5)$$

$$\Delta L = 0.412h\frac{(\varepsilon_{eff}+0.3)\left(\frac{w}{h}+0.264\right)}{(\varepsilon_{eff}-0.258)\left(\frac{w}{h}+0.813\right)} \quad (6)$$

Where, C is the velocity of light, ε_r is the dielectric constant of substrate, (f_o) is the resonance frequency,**k**$_0$=phase constant=2π/λ, ΔL the distance, and εeff = effective dielectric constant. The proposed antenna produces broadband with omni- directional radiation pattern. The wide bandwidth and wide impedance matching with reduced size of the antenna is achieved due to resultant of different surface magnetic currents.

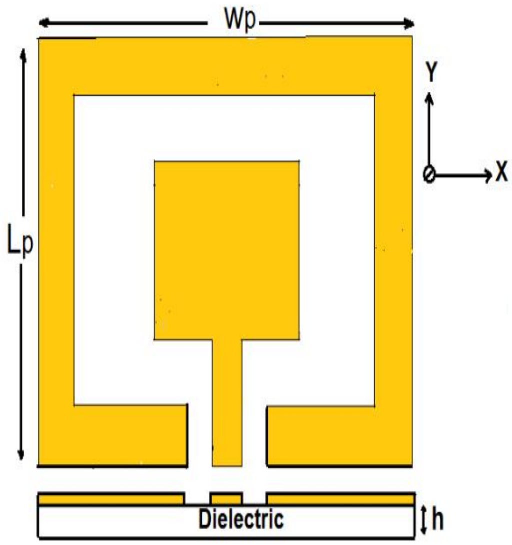

Figure-1. Original CPW-fed monopole patch antenna.

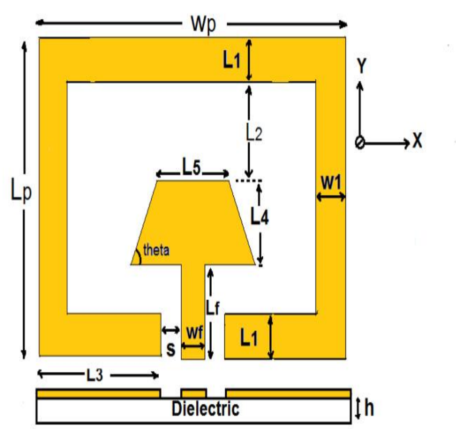

Figure-2. Finale structure proposed antenna.

3.simulation and results .

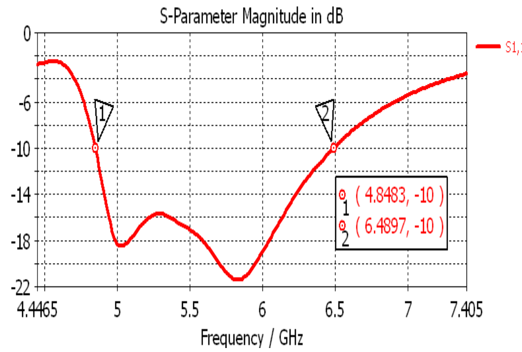

Figure-3. Return loss for proposed antenna

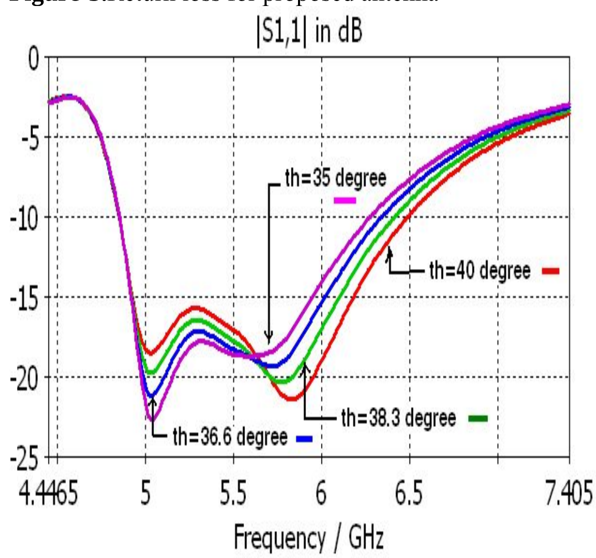

Figure-4. Return loss for theta with different values (40°, 38.3°, 36.6°, 35°) degree.

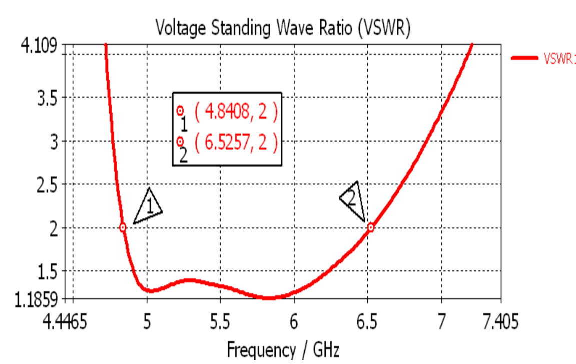

Figure-5. VSWR for proposed antenna.

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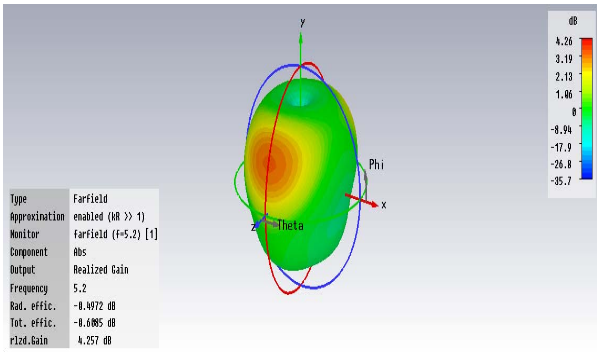
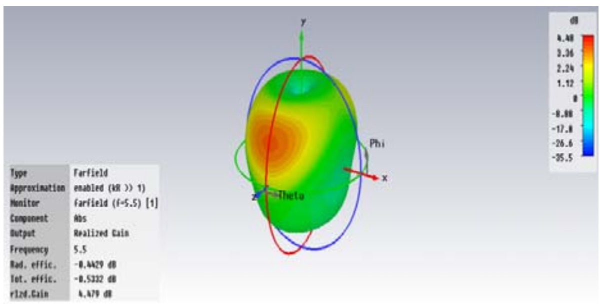
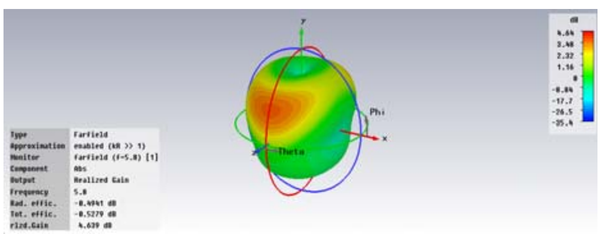


(a)

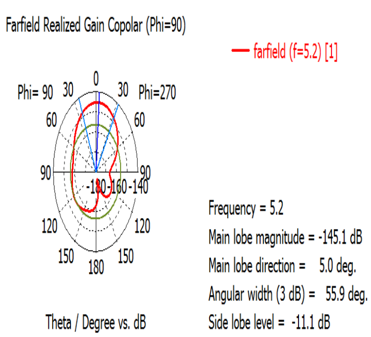


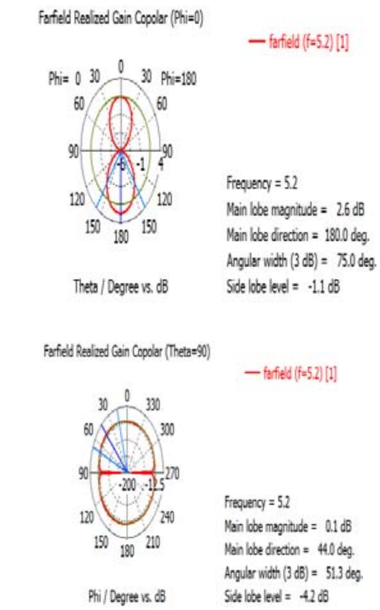
(b)



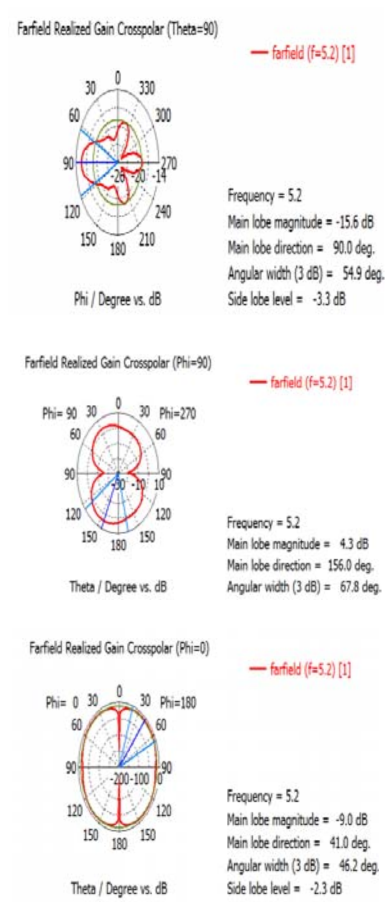
(c)

Figure-6. 3D radiation pattern for (a) 5.2, (b) 5.5, and (c) 5.8 GHz.





(a)



(b)

Figure-7. Radiation pattern at F= 5.2 GHz (a) copolar (b) crosspolar.

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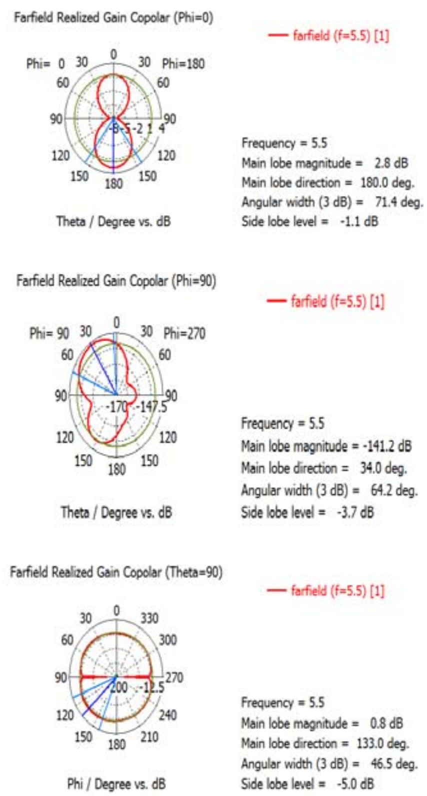
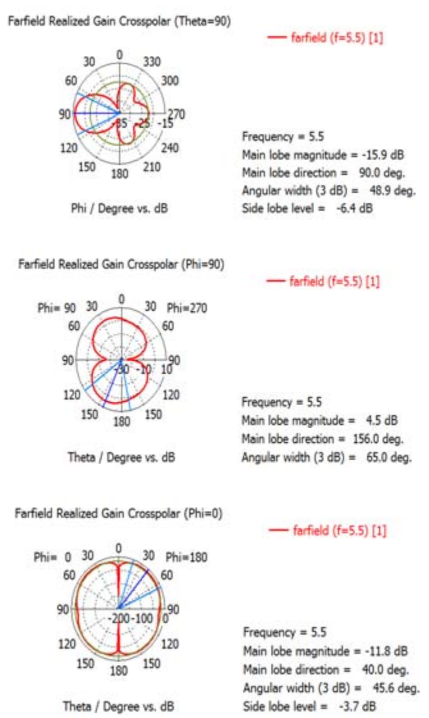
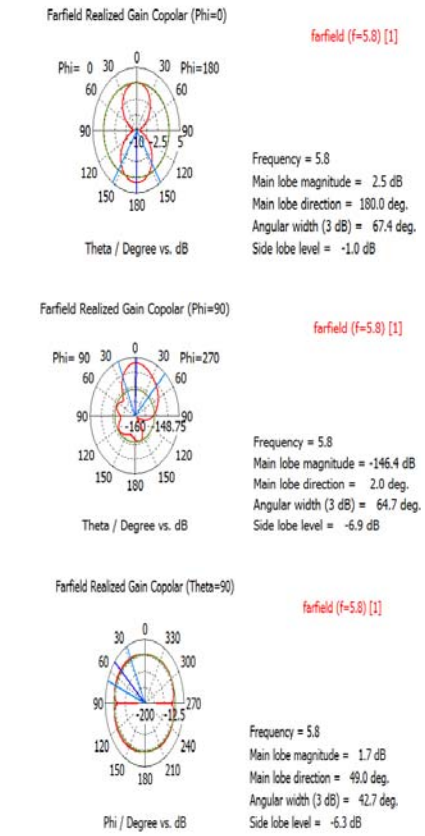


(a)

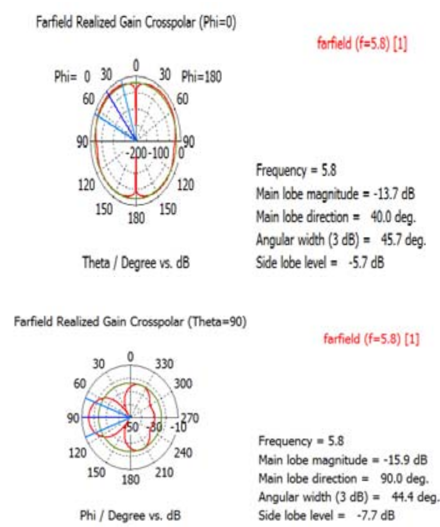


(b)

Figure-8. Radiation pattern at f =5.5 GHz (a) copolar (b) crosspolar.



(a)



(b)

Figure-9. Radiation pattern at f= 5.8GHz (a) copolar (b) crosspolar.

The proposed planar monopole antenna has been simulated through the finite integration technology (FIT) in (CST-2012) microwave package. CPW-fed monopole proposed antenna as displayed in Figure-2 the simulated return loss of the proposed antenna is shown in Figure-3,

VOL. 10, NO. 1, JANUARY 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

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which clearly indicates that the impedance bandwidth of the antenna is 1641.4 MHz (4.8483-6.4897) GHz for return loss (S_{11}) <-10dB, abroadband is achieved that covers the 5.2 / 5.8 and 5.5 GHz WLAN, WiMaX respectively. the resonant frequency and bandwidth are controlled by the size of the rectangular slot, antenna and tuning stub. the simulated return loss for theta with different degree (theta=36.6°, 38.3°, 35° and 40° degree) is displayed in Figure-4 the response clearly, a significant variation in the impedance bandwidth is observed when (theta=40° degree). Hence, theta is one of the parameters which affect the impedance matching and impedance bandwidth. The simulated results of VSWR<2, is shown in Figure-5. Figure 6, 7, 8, and 9; show the radiation patterns the antenna has stable radiation patterns over the broadband as omni-directional pattern.

Table-1. The parameters of proposed antenna.

Parameters	Value
VSWR for 5.2,5.8, and 5.5GHz Respectively.	1.38,1.192 and 1.33
The bandwidth of the antenna	1641.4 MHZ
The gain at 5.2 GHz	4.26 dB
The gain at 5.8GHz	4.64 dB
The gain at 5.5 GHz	4.48 dB

4. CONCLUSIONS

A novel a broadband CPW-fed monopole antenna with a trapezium-shaped stub is presented. Its geometry has simple structure and less parameters (theta and L_f) the simulation results show that the proposed antenna can offer good performance for broadband application ranging from 4.8483 GHz to 6.4897GH. Proposed antenna achieved-10dB impedance bandwidth of 1641.4MHz for 5.2 / 5.8 and 5.5 GHz WLAN and WiMaX respectively.

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