International Journal of Emerging Technology and Innovative Engineering
Volume I, Issue 5, May 2015 (ISSN: 2394 – 6598)

Dual Band Half Wave Dipole Antenna for Different Dielectric Substrate Materials

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ABSTRACT

Dual band half wave Dipole antenna for different dielectric substrates are proposed for multiple applications. The different substrates are aluminum, copper, roger. These substrates used designed antenna peaks are Aluminum 4.6&14.2GHz,Copper 4.2&11GHz and Roger 4.6&14GHz.It is used for live online Game, real-time video streaming and mobile electronic devices high speed data sharing, satellite applications. This design half wave dipole antenna is designed and simulated over CST-MWS simulation software. The designed antenna is characterized by measuring return loss, radiation pattern, directivity, gain and efficiency.

Keywords
Half wave dipole Antenna, CST MWS, Far -field radiation

1. INTRODUCTION

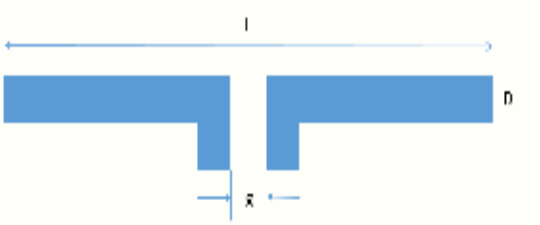

Fig. 1: Half-Wave Dipole Antenna

A general construction of a half-wave dipole antenna has been shown in the Fig.1. There is a gap between two arms of half-wave dipole antenna for feeding purpose. Here L is the total length of the antenna, D is the thickness of antenna arm and g is the feeding gap. Radiation resistance of the half-wave dipole is 73 Ohm which matched with the line impedance.

2. DESIGN PARAMETERS

Dimension of an antenna changes based on the resonant frequency. As a resonant frequency 7GHz has been chosen. By taking this into consideration several antenna dimension have been calculated.

Resonant frequency, f_r=7 GHz……. [1]

Wavelength,

$\lambda = c/fr$……. [2]

$c=3*10^8$m/s

Length of half wave dipole antenna,

$L=143/f$……..... [3]

Feeding gap of antenna,

$G=L/200$……..... [4]

Radius of wire,

$R=\lambda/1000$……..... [5]

From the first equation, wavelength has been calculated based on which length of the dipole antenna has been found from the second equation. Feeding gap and radius of the wire have been calculated from the equation no3,4and5 respectively. All dimensions of the antenna are given in the Table 1.

Substrate	Roger	Aluminum	Copper
Resonant frequency	7	7	7
Wavelength of dipole	44	8	54
Length of dipole	33	21	37
Radius of dipole	0.25	0.15	0.268
Feeding gap	31	10	1.5

Table 1: Design Parameters of the Antenna

3. SIMULATIONS AND RESULTS

3.1. Simulations

According to the design parameters a half- wave dipole antenna has been designed in CST MWS. In the Fig.2 designed half-wave dipole antenna has been shown

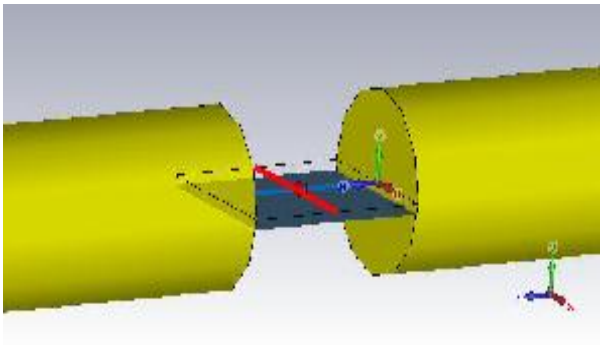

Fig. 2: Designed Half-Wave Dipole Antenna

For the simulation purpose the ranges of frequencies have been chosen from 7GHz. For making the simulation fast and more accurate global mesh properties have been optimized. As antenna aluminum has been used and between the two antenna arms a sheet has been selected.

3.2. Results

After the simulation return loss has been Observed

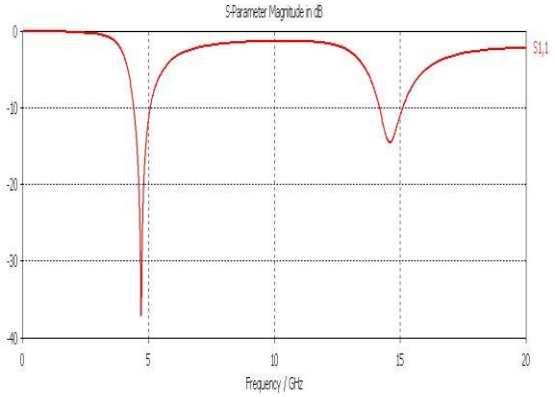

Fig 3.1 : Return loss curve for the designed Half Wave Dipole Antenna using roger substrate

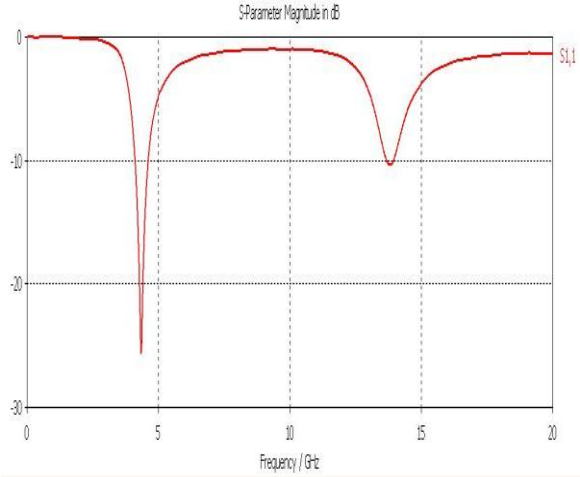

Fig 3.2 : Return loss curve for the designed Half Wave Dipole Antenna using aluminum substrate

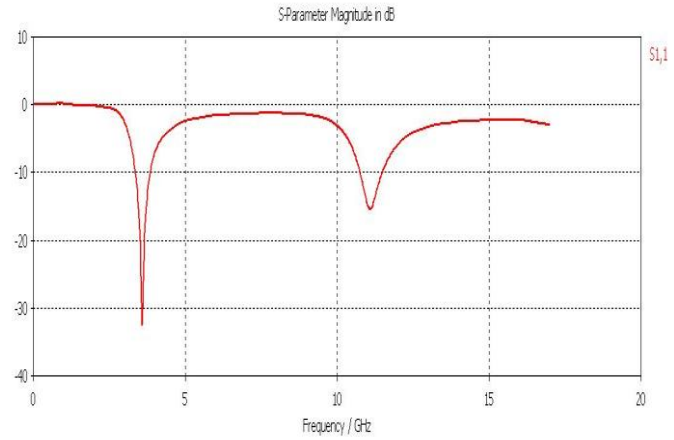

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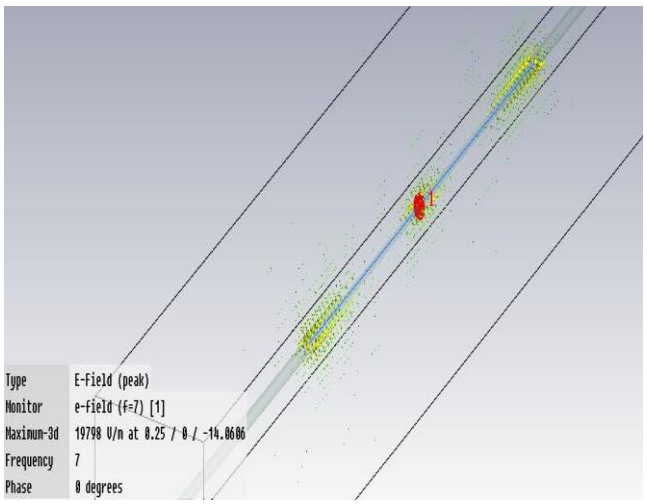
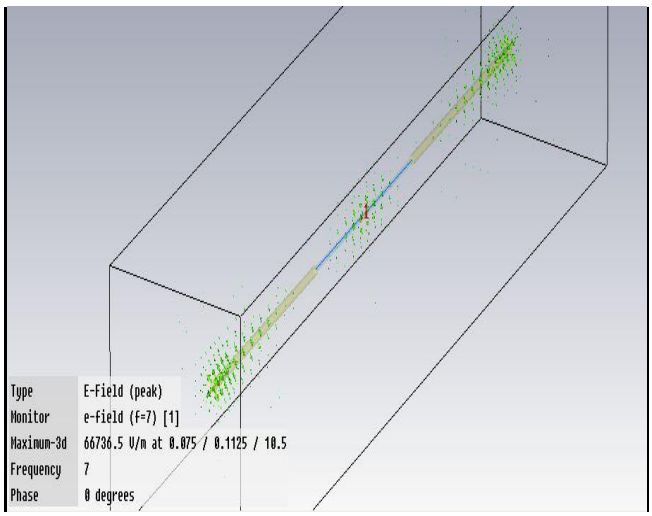
Fig 3.3 : Return loss curve for the designed Half Wave Dipole Antenna using copper substrate

From the Fig.3 authors have found that the antenna is resonating at 7GHz. Moreover, the value of return loss has been found as 7.43 dB.





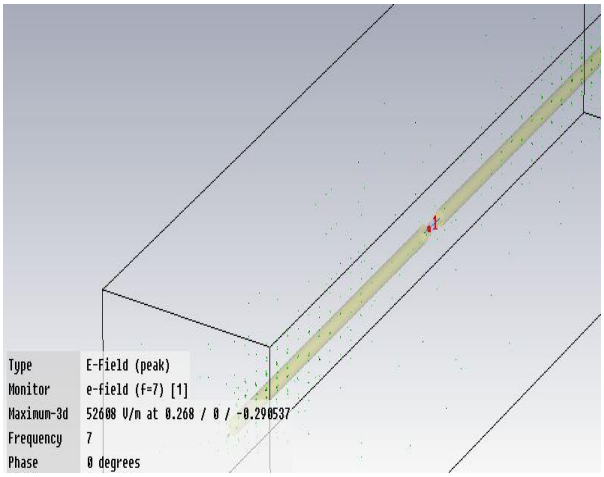


Fig 4: E-field EM wave propagation of half wave dipole antenna

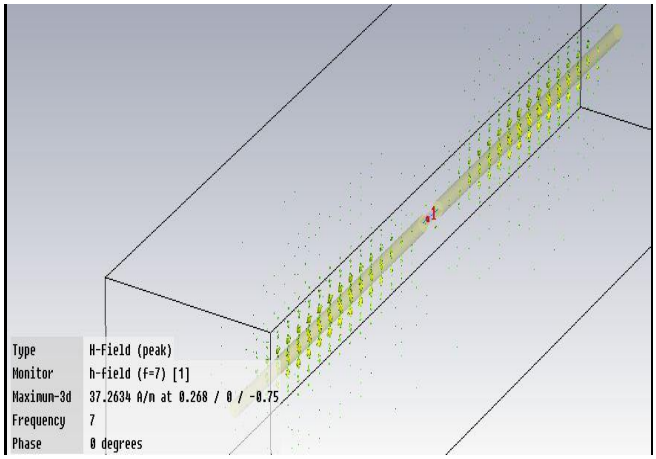
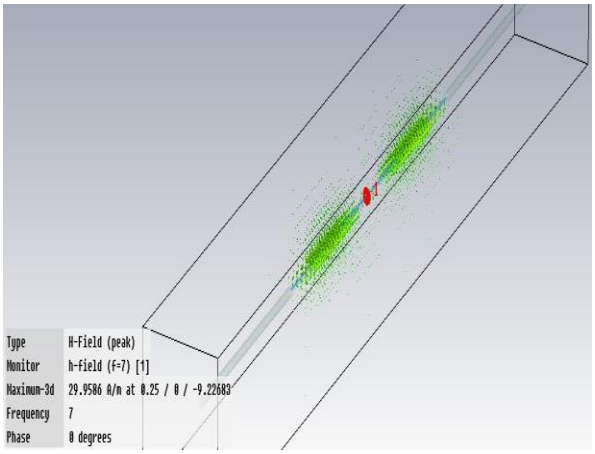
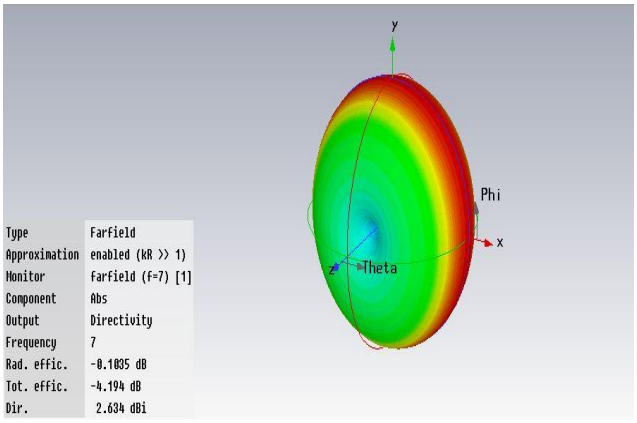
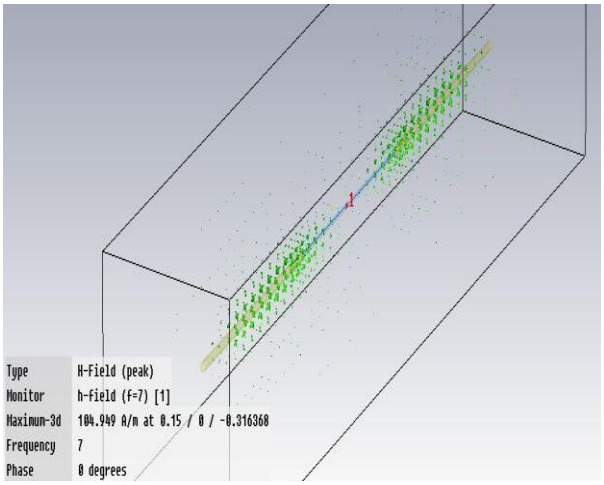
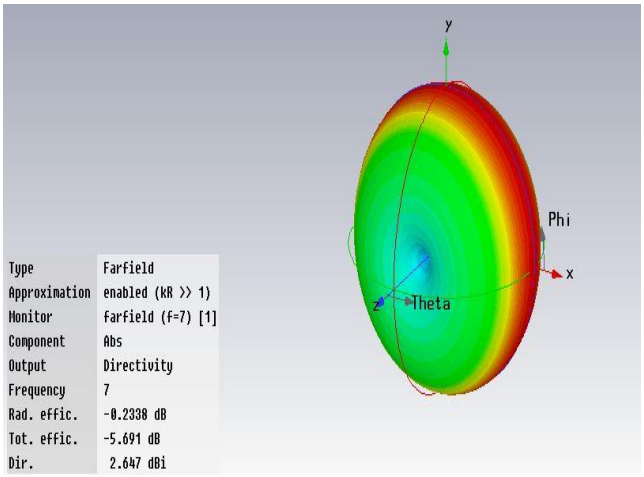


Fig 5: H-field EM wave propagation of half wave dipole antenna









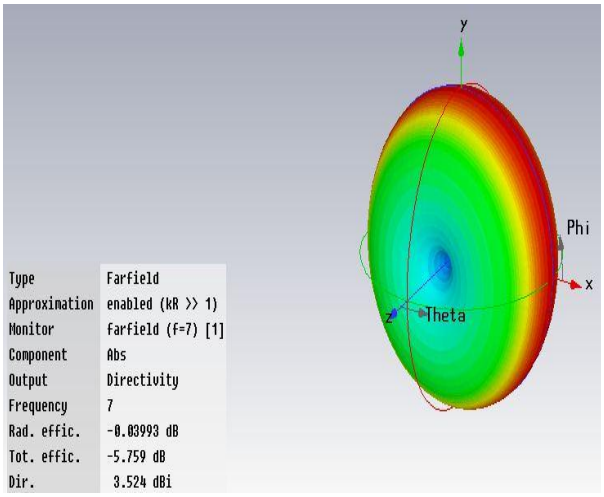
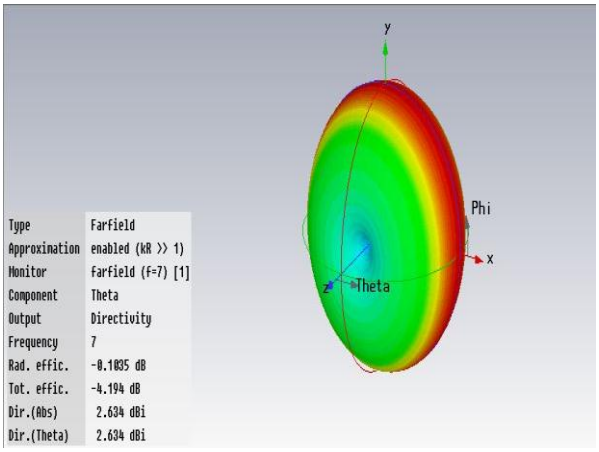
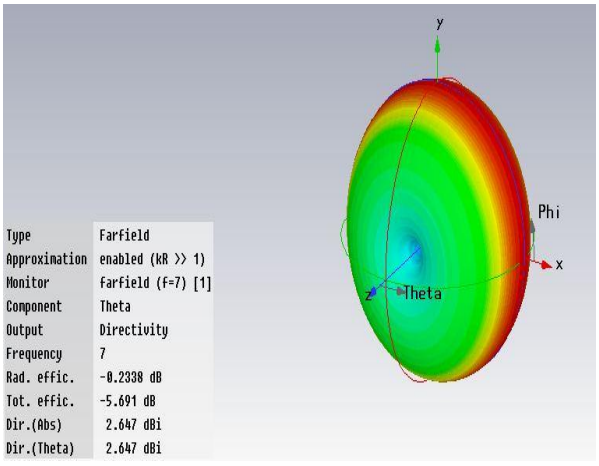
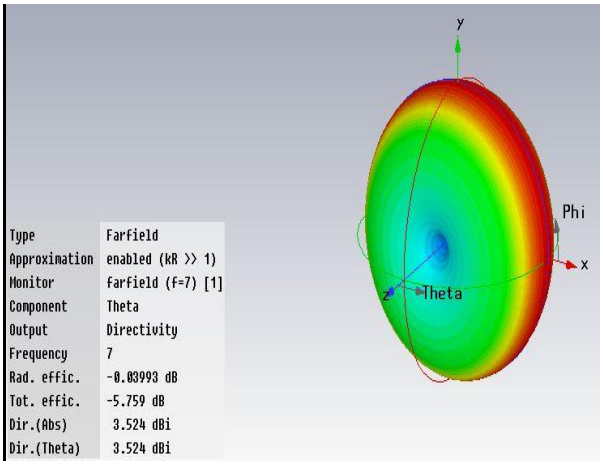


Fig 6:3-D Far field radiation pattern for Directivity of designed Half Wave Dipole Antenna







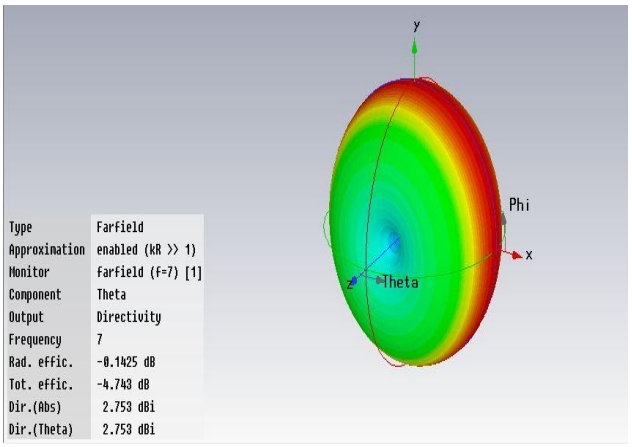
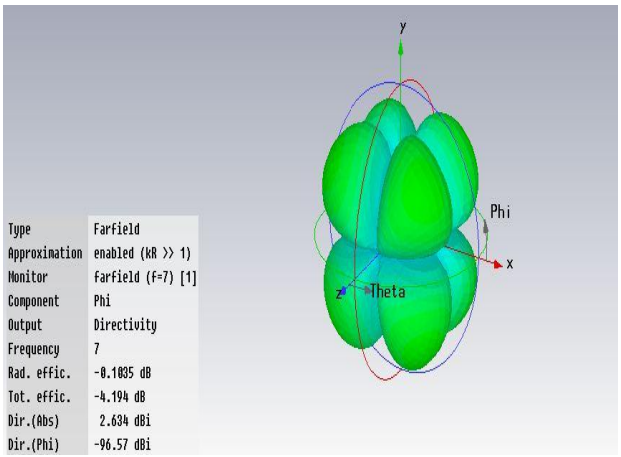
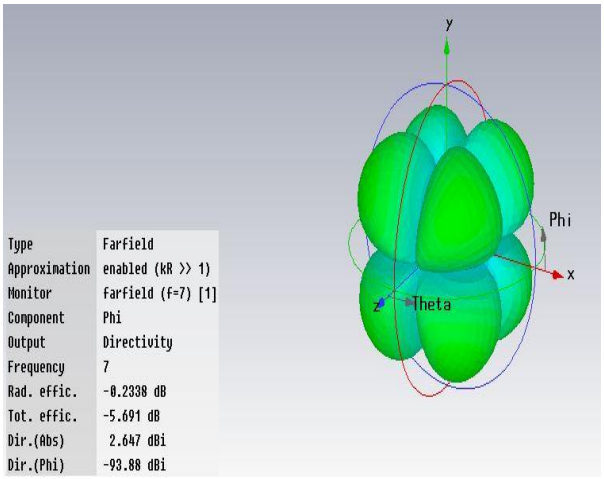


Fig 7: 3-D theta farfield radiation pattern of Half wave Dipole Antenna





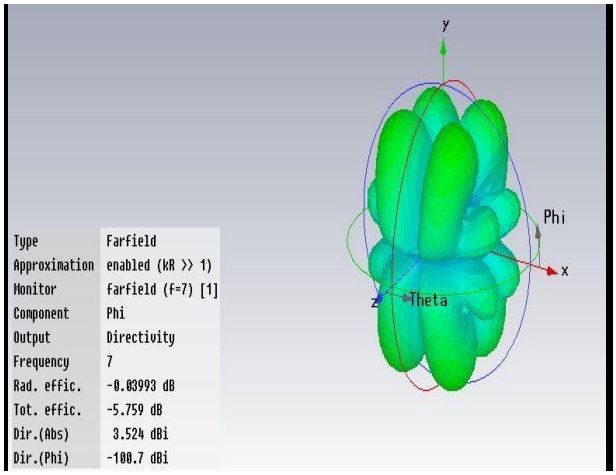


Fig 8: 3-D phi far field radiation pattern of Half wave Dipole Antenna

Far-field radiation [6] pattern has been shown in the Fig. 9. Directivities has found as Roger 2.753dBi, Aluminum 2.647dBi & Copper 3.524dBi.Obtained directivities were almost identical to the theoretical one. Red color shows the maximum radiation Gain has found the simulation which has shown in the Fig. 10. Summary of the simulated results are given in the Table 2.

Parameter	Roger	Aluminum	Copper	Units
Resonant frequency(fr)	7	7	7	GHz
Directivity	2.753	2.647	3.524	dBi
Total efficiency	-4.743	-5.691	-5.759	dB
Radiation efficiency	-0.1425	-0.2338	-0.03993	dB

4. CONCLUSIONS

Main objective of this paper was to observe the several antenna characteristics for popular wire antenna. As a popular Practical antenna half-wave dipole antenna was selected. Obtained results were acceptable for practical implementation of these types of antennas. As a simulation tool CST Microwave Studio was used which ease the simulation. Obtained resonant frequency (7 GHz) which is acceptable. There are few scopes to improve the results by optimizing several parameters which might be fruitful for researchers. Author would like to work on these in future

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