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PATCH ANTENNA (FOR DRONE SYSTEM)

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Submitted to – **Dr. Paritosh Peshwe**

Aim: We are designing a patch antenna for defence drone system using CST software and its working frequency is 5.7Ghz also doing fabrication part.

Theory: The microstrip consists of a very thin metallic strip placed on a ground plane with a dielectric material in-between. The radiating element and feed lines are placed by the process of photo-etching on the dielectric material. Usually, the patch or microstrip is chosen to be square, circular or rectangular in shape for the ease of analysis and fabrication.

ANTENNA DESIGN

Designing For designing of a microstrip patch antenna, we have to select the resonant frequency and a dielectric medium for which antenna is to be designed. The parameters to be calculated are as under. Width (W): The width of the patch is calculated using the following equation.

$$W = \frac{C0}{2fr}\sqrt{\frac{2}{\mathcal{E}r+1}} \quad \text{..................................} \quad (1)$$

Where, W = Width of the patch, f r = Frequency of operation, $C0$= Speed of light, εr = Dielectric constant of substrate

Effective dielectric constant ($\mathcal{E}ef$): The effective dielectric constant value of a patch is an important parameter in the designing procedure of a microstrip patch antenna. The radiations travelling from the patch towards the ground pass through air and some through the substrate (called as fringing). Both the air and the substrates have different dielectric values, therefore in order to account this we find the value of effective dielectric constant. The value of the effective dielectric constant (εeff) is calculated using the following equation

$$\varepsilon eff = \frac{\varepsilon r+1}{2} + \frac{\varepsilon r-1}{2}\left[1 + 12\frac{h}{w}\right]^{-0.5} \text{..............} (2)$$

Length: Due to fringing, electrically the size of the antenna is increased by an amount of (ΔL). Therefore, the actual increase in length (ΔL) of the patch is to be calculated using the following equation.

$$\frac{\Delta L}{h} = 0.412\,\frac{(\varepsilon eff+0.3)\left(\frac{w}{h}+0.264\right)}{(\varepsilon eff-0.258)\left(\frac{w}{h}+0.8\right)} \text{........................} (3)$$

Where ‘h’= height of the substrate The length (L) of the patch is now to be calculated using the below mentioned equation.

$$L = \frac{1}{2fr\sqrt{\varepsilon eff\ \mu_0\varepsilon_0}} - 2\Delta L \text{..................................} (4)$$

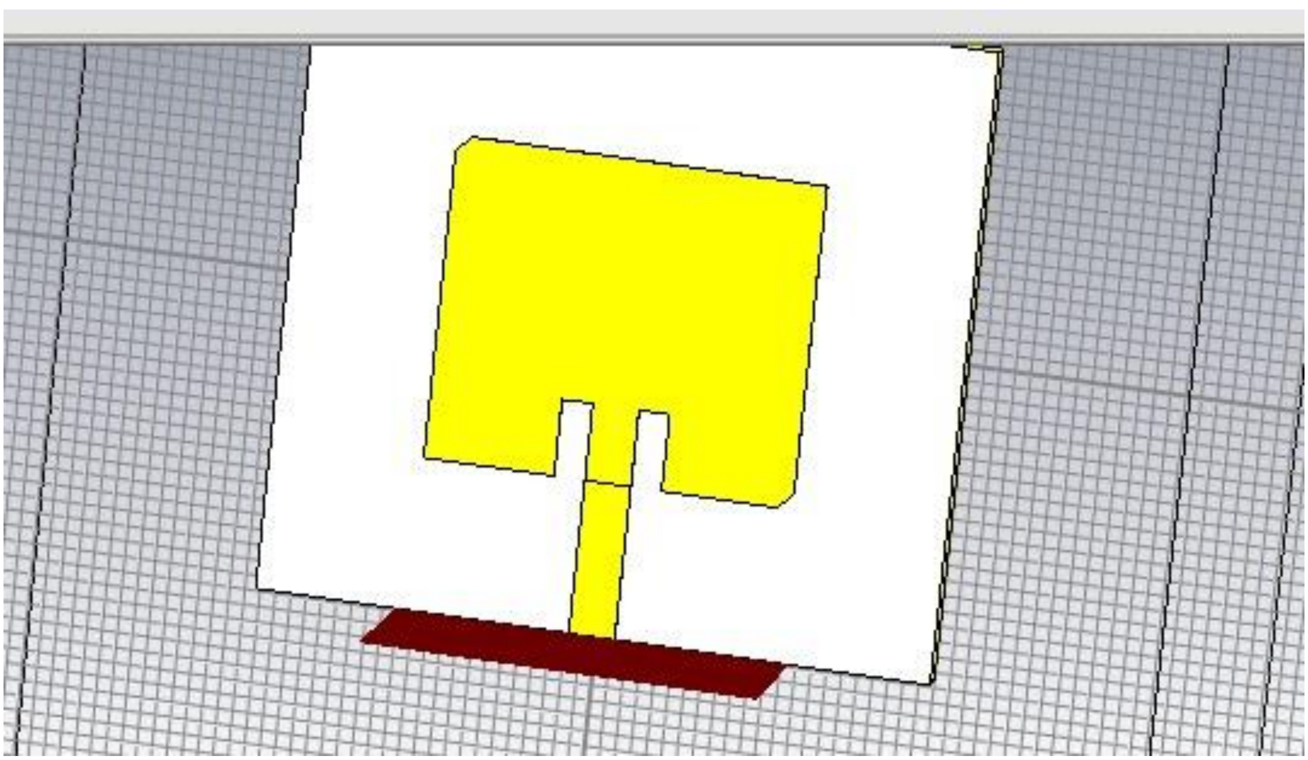
Length (Lg) and width (Wg) of ground plane: Now the dimensions of a patch are known. The length and width of a substrate is equal to that of the ground plane. The length of a ground plane (Lg) and the width of a ground plane (Wg) are calculated using the following equations.

Lg = 6h + L .... (5)

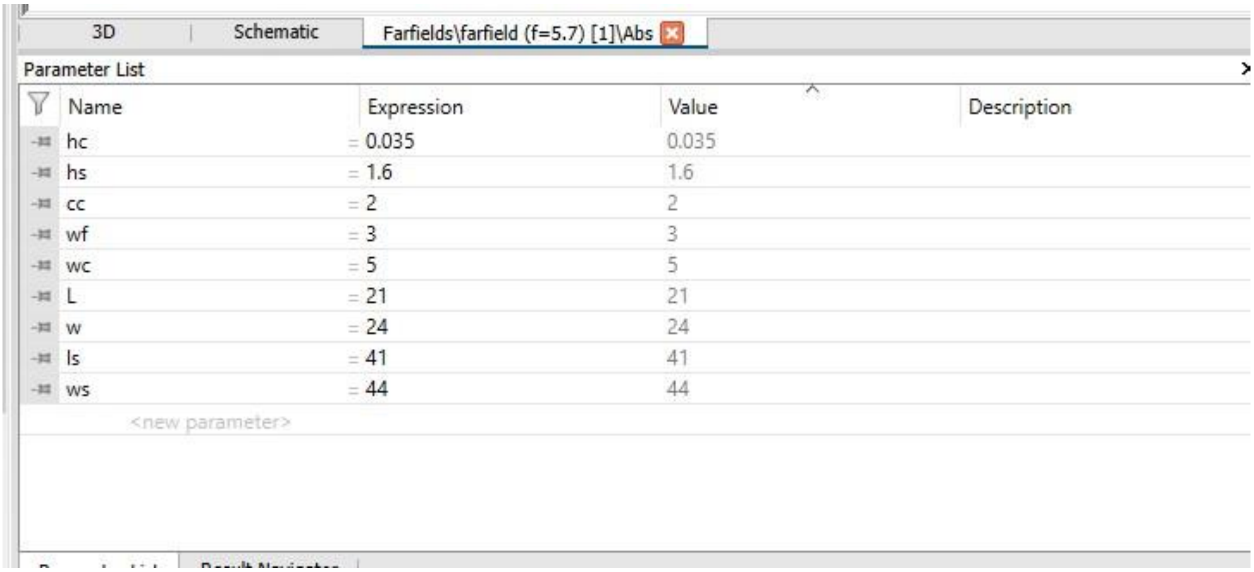
Wg = 6h + W ....(6)

<u>Antenna far field -</u> the far field of an antenna is generally considered to be the region where the outgoing wavefront is planer and the antenna radiation pattern has a polar variation and is independent of the distance from the antenna.

Patch design-

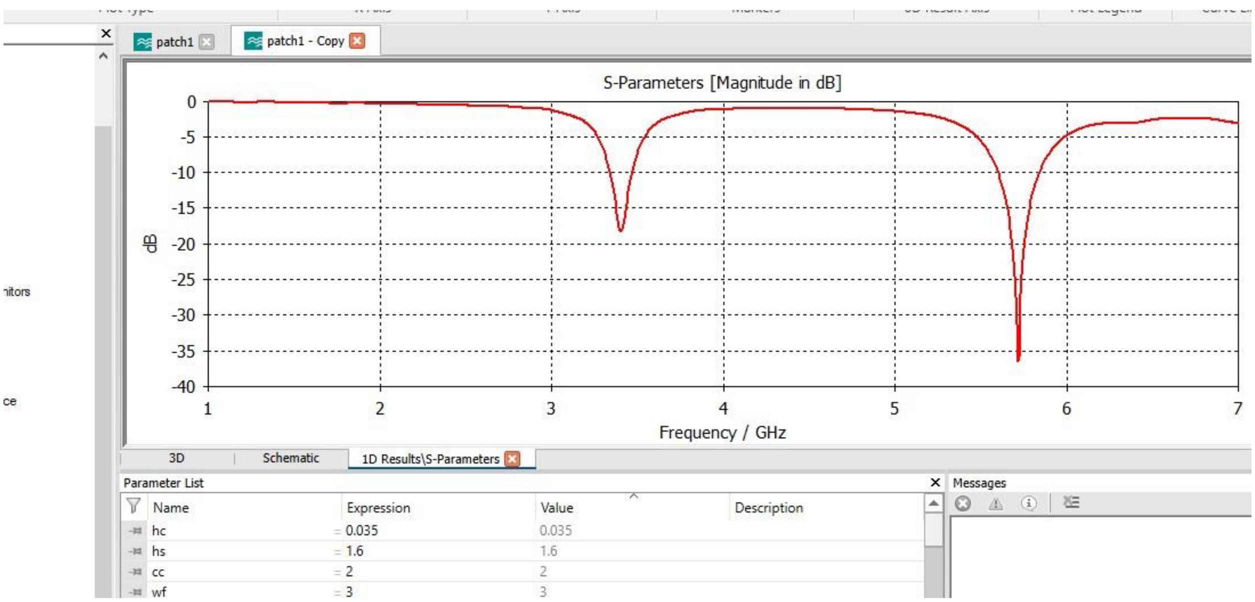


Parameters-

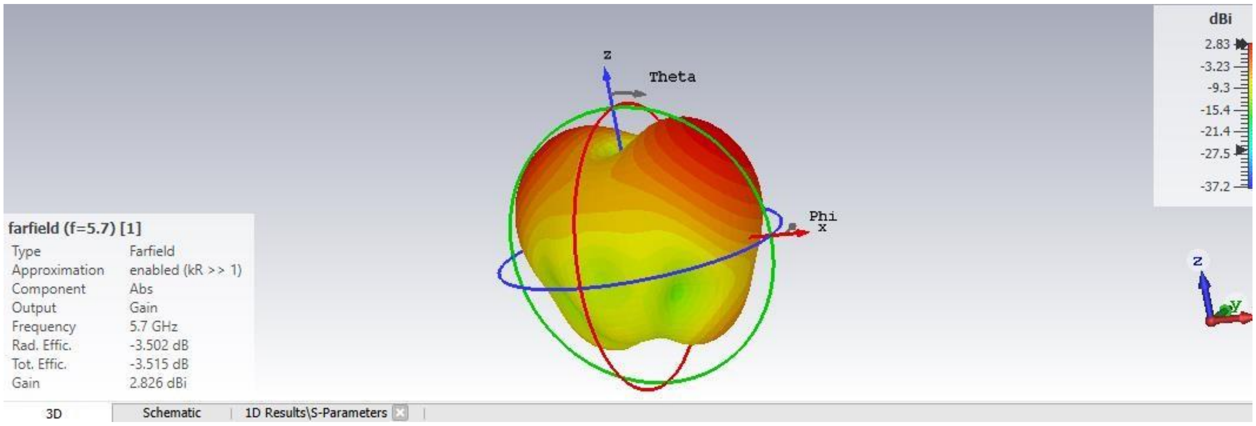


Name	Expression	Value	Description
hc	= 0.035	0.035	
hs	= 1.6	1.6	
cc	= 2	2	
wf	= 3	3	
wc	= 5	5	
L	= 21	21	
w	= 24	24	
ls	= 41	41	
ws	= 44	44	
<new parameter>			

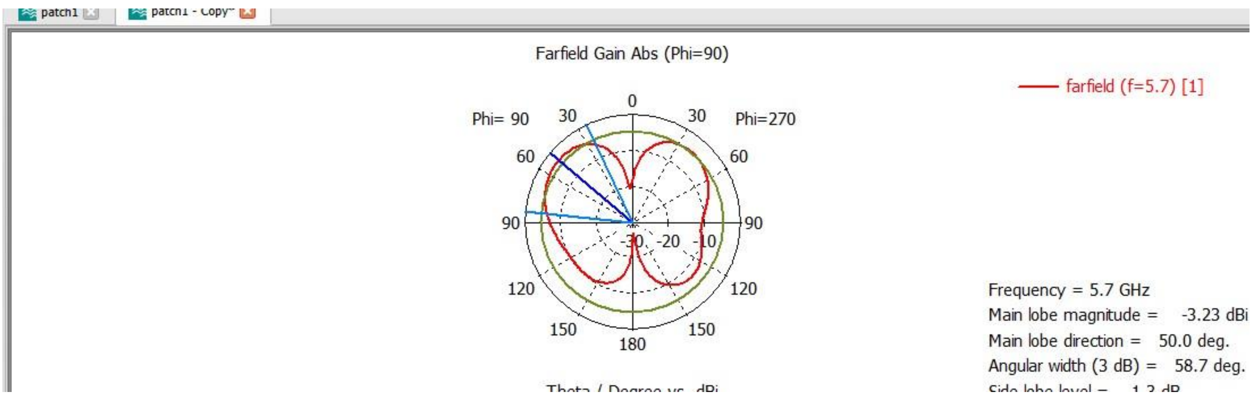
S parameter-



Farfield-



dBi
2.83
-3.23
-9.3
-15.4
-21.4
-27.5
-37.2
z
Theta
Phi
x
farfield (f=5.7) [1]
Type Farfield
Approximation enabled (kR >> 1)
Component Abs
Output Gain
Frequency 5.7 GHz
Rad. Effic. -3.502 dB
Tot. Effic. -3.515 dB
Gain 2.826 dBi
3D
Schematic
1D Results\S-Parameters



patch1
patch1 - Copy*
Farfield Gain Abs (Phi=90)
farfield (f=5.7) [1]
Phi= 90
Phi=270
0
30
30
60
60
90
90
120
120
150
150
180
-30
-20
-10
Frequency = 5.7 GHz
Main lobe magnitude = -3.23 dBi
Main lobe direction = 50.0 deg.
Angular width (3 dB) = 58.7 deg.