STUDY AND ANALYSIS OF BROADSIDE -ANTENNA ARRAY USED FOR 2GHz FREQUENCY.

ABSTRACT:

- In this report, a broadside antenna array is designed which is used for 2.2GHz frequency.
- 5 GHz WLAN connections are used around the home and offices to eliminate the use of cables when sharing printers, scanners, and high-speed internet connections.
- Optimum design is used to get maximum output characteristics. We aim to design a broadside array antenna with maximum gain at a frequency of 2 GHz.

KEYWORDS: Directivity, s-parameters, combined gain, dipole, spacing between dipoles.

Introduction: Broadside array is a linear or a planar array antenna whose direction of maximum radiation is perpendicular to the line or plane of the array. We have used 2 identical dipoles with same excitation current in both dipole. The direction of ports used in both the dipoles is same. Also the current is in phase.

The maximum array factor occurs when

$$\psi = kd\cos\theta + \beta = 0$$

Since it is desired to have maximum directivity towards θ = 90',

$$\boxed{\Psi = kd\cos\theta + \beta|_{\theta=90'} = \beta = 0}$$

Thus to have a maximum array factor of uniform linear array directed broadside to the axis of the array it is Necessary that both elements have the same phase excitation.
We can vary the length of the dipole and the distance between them to observe the trend for results.

Theory:

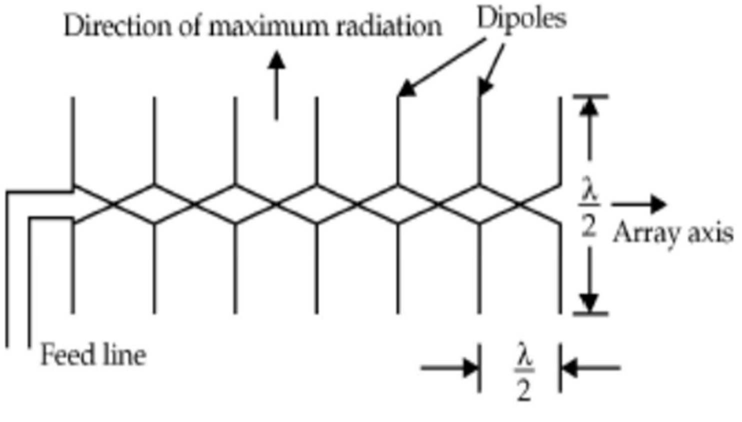
Broadside array is an array which gives a radiation pattern whose main beam is perpendicular to the axis of the array.

In a wider sense, broadside array is a linear or a planar array antenna whose direction of maximum radiation is perpendicular to the line or plane of the array.

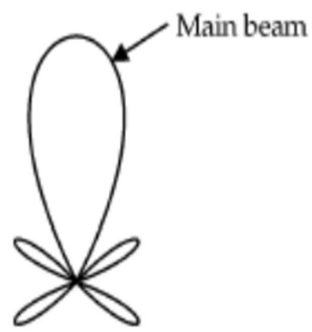
Salient features of broadside arrays

- A number of dipoles of equal size are used.
- The elements are spaced equally.
- All the dipoles are fed in the same phase.
- The null-to-null beamwidth of broadside array.

Radiation Pattern:



Broadside array



radiation pattern

Beam width between first Nulls (BWFN)= (2λ /Nd)

Where λ = wavelength

N = number of elements

d = spacing between the elements

Features:

- The length of the broadside array can be 2 to 10λ.
- Typical spacing between the elements varies from λ/2 to λ.
- The number of elements to be used depends on the beam width requirement, cost, and space available.
- A broadside array is often used along with a reflector antenna. The back lobe is now reflected forward and adds to the forward lobe.
- When a broadside array is used with a reflector, it is possible to improve its gain and directivity and the broadside array becomes uni-directional.
- This array is often used in overseas broadcast systems.
- It is used for LF, MF, HF and the higher band of frequencies.

Conditions :

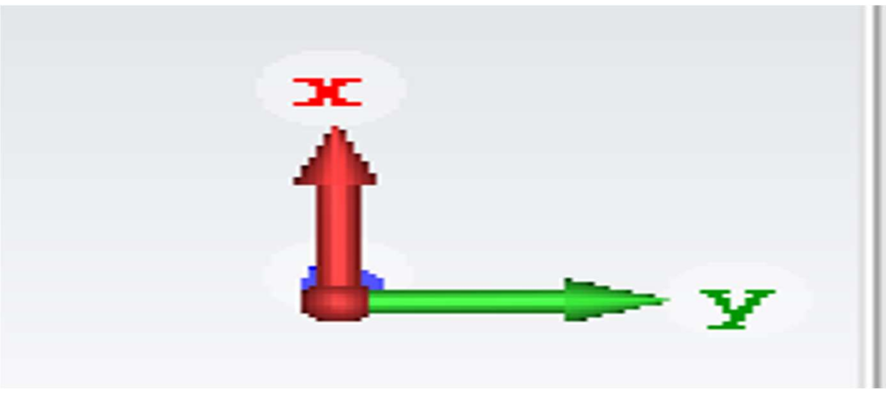
lam/4<= h <=lam/2

lam/4<= d <=lam/2

Procedure (CST) :

The height of 2 dipoles and the spacing between them is varied and the combined gain and s-parameters (S11) are observed for various combinations using CST software.

In my Antenna My array axis is y-axis



Design parameters :

3D | Schematic

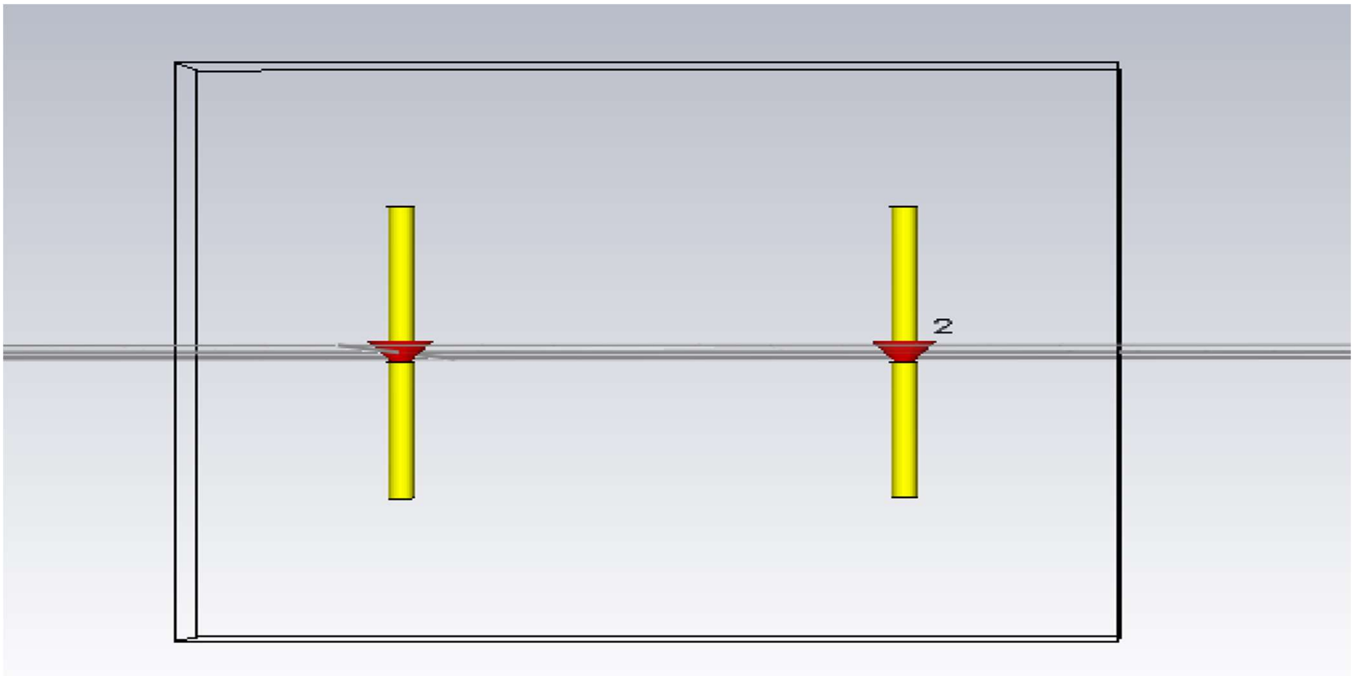
Parameter List

Name	Expression	Value	Description
h	= lem*0.414	62.0586	Height
d	= lem*0.5	74.95	Distance
lem	= 149.90	149.90	Wavelength
s	= 4	4	Slot Length
c	= 3*10^11	300000000000	Speed Of Light
freq	= 2*10^9	2000000000	Frequency
r	= 2	2	Radius

<new parameter>

Here,
f=frequency
c0=speed of light
lam=wavelength
h=height of dipole
r=radius of dipole
s= side of the cubical slot cut from the centre of dipole for excitation purpose.
d=spacing between two dipoles.

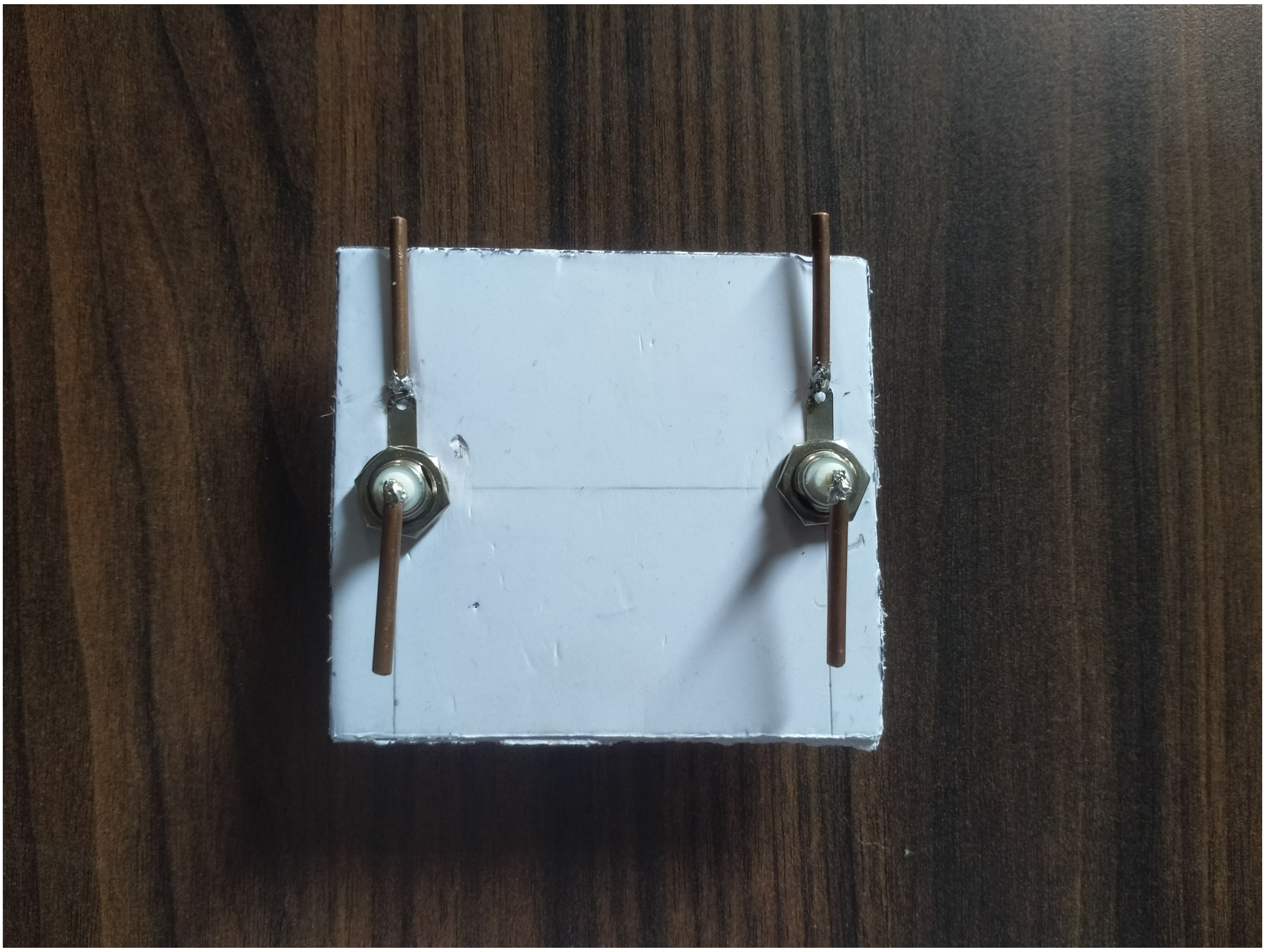
Components Picture:



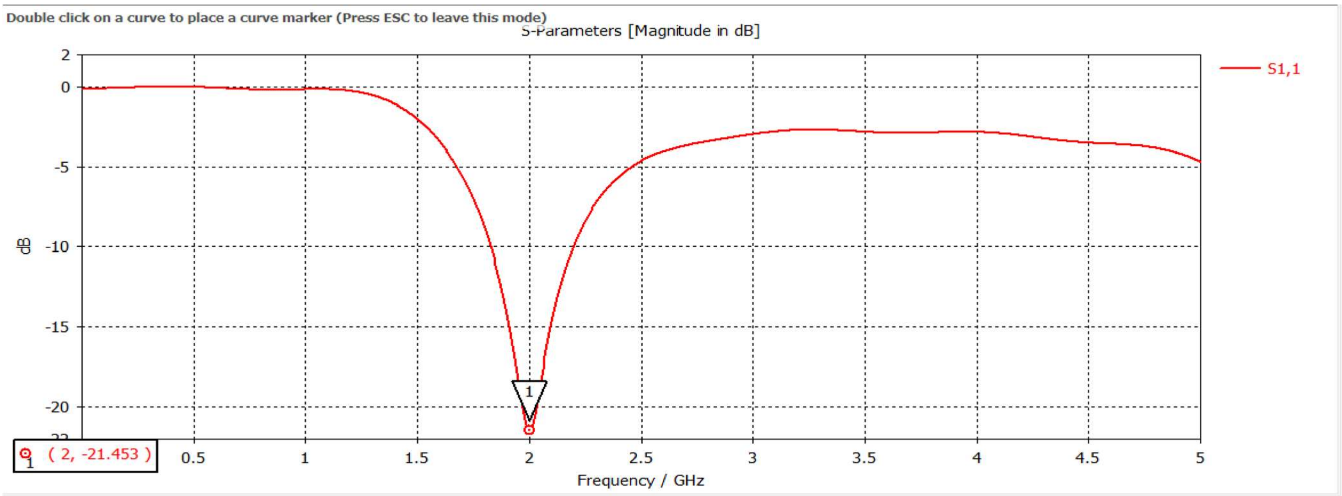
Construction:

1. Take a cylinder and fill in the dimensions of the wire.
2.Choose the material to be copper annealed.
3.Take a cube for the slot.
4. Fill in the dimensions such that it appears at the centre of the wire.
5.Subtract the portion corresponding to the cube from the wire using Boolean >Subtract.
6.Select the centre of the faces facing each other in the slot.
7.Connect a discrete port between them.
8.Now follow the same procedure from second dipole and place it at distance ‘d’ along y-axis.
9.Now select the required far-fields from the far-field monitor and set the frequency.
10.Start the simulation.
11.For observing combined results, go to post->processing->select frequency->select amplitude and phase difference ->combine.

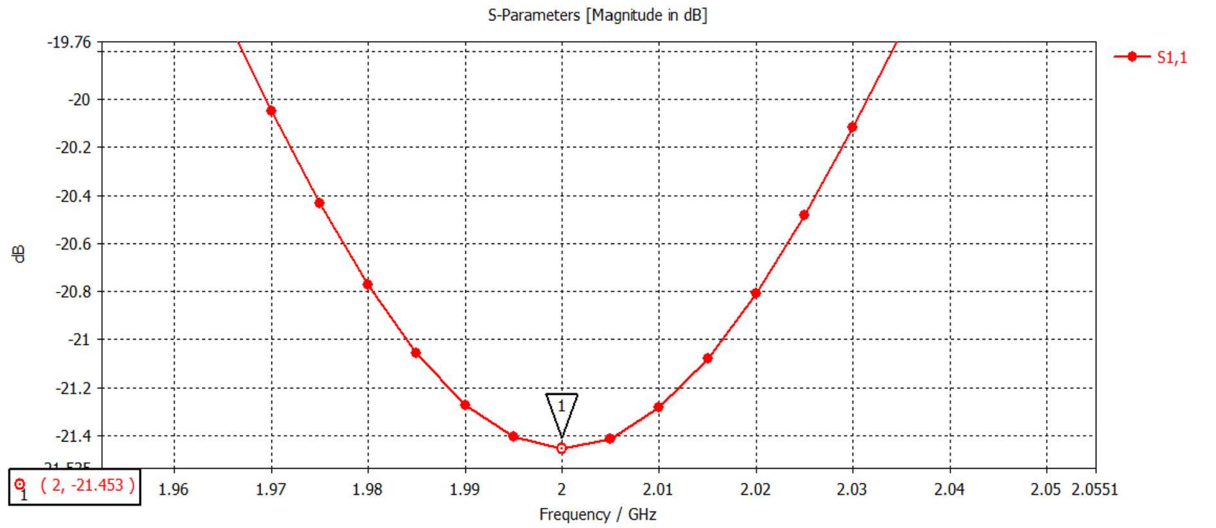
Fabricated Picture:



Results and analysis of Broadside array antenna:

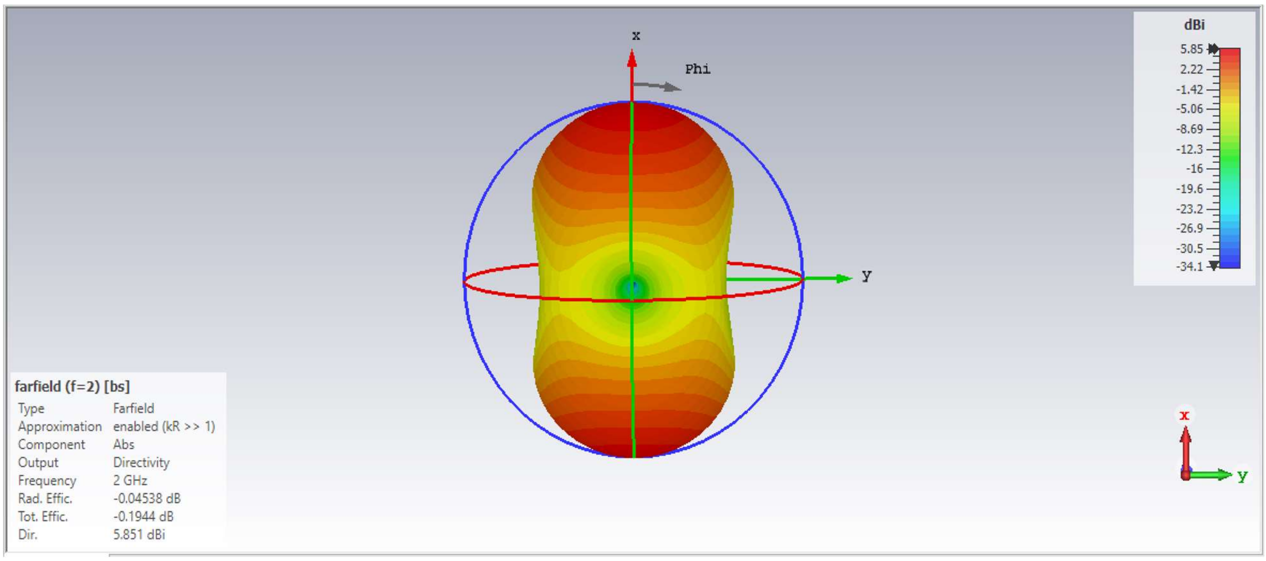


S-parameters ->S1,1



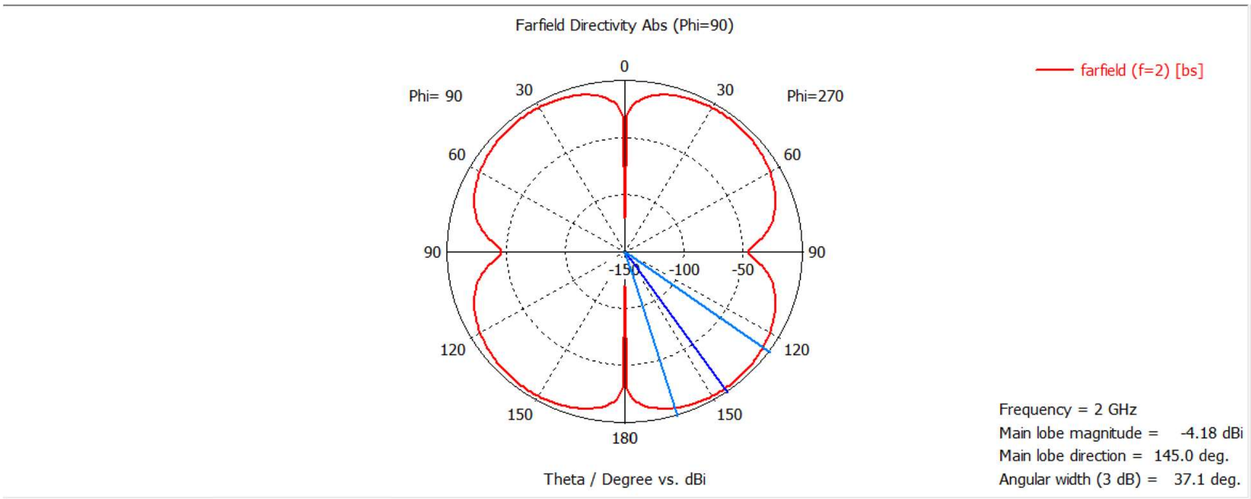
Here we see that we have obtained a resonance exactly at 2Ghz which is the desired operating frequency. Also a dip of -21.453 dB is observed at the operating frequency.

Far-Field :



Combined gain at 2 Ghz

Polar:



Observations:

S.NO	HEIGHT	DISTANCE	S11 AT 2 (GHZ)	GAIN(DB)
1)	0.35*LEM	LEM*0.1	-3.1541	2.156
		LEM*0.15	-3.1192	2.395
		LEM*0.20	-2.8841	2.702
		LEM*0.25	-2.567	3.069
		LEM*0.30	-2.3683	3.557
		LEM*0.35	-1.9644	4.142
		LEM*0.40	-1.7343	4.844
		LEM*0.45	-1.4685	5.643
		LEM*0.50	-1.3529	6.395
2)	0.40*LEM	LEM*0.1	-6.6353	2.087
		LEM*0.15	-6.3758	2.265
		LEM*0.20	-6.4758	2.473
		LEM*0.25	-6.0908	2.792
		LEM*0.30	-5.8054	3.148
		LEM*0.35	-5.4459	3.589
		LEM*0.40	-5.0276	4.716
		LEM*0.45	-4.9201	5.33
		LEM*0.50	-5.0424	5.872
3)	0.41*LEM	LEM*0.1	-7.1168	2.285
		LEM*0.15	-7.0758	2.497
		LEM*0.20	-6.8738	2.792
		LEM*0.25	-6.6353	3.148
		LEM*0.30	-6.5217	3.686
		LEM*0.35	-6.4102	4.012
		LEM*0.40	-6.2313	4.827
		LEM*0.45	-6.1387	5.312
		LEM*0.50	-6.4194	5.838
4)	0.42*LEM	LEM*0.1	-7.4809	2.319
		LEM*0.15	-7.0758	2.525
		LEM*0.20	-7.9614	2.934
		LEM*0.25	-7.4995	3.19
		LEM*0.30	-7.1076	3.41
		LEM*0.35	-6.0135	3.527
		LEM*0.40	-7.1234	4.618
		LEM*0.45	-7.5829	5.309
		LEM*0.50	-8.0715	5.831
5)	0.43*LEM	LEM*0.1	-7.585	2.352
		LEM*0.15	-7.829	2.518
		LEM*0.20	-8.135	2.859
		LEM*0.25	-8.681	2.971
		LEM*0.30	-9.012	3.314
		LEM*0.35	-9.473	3.826
		LEM*0.40	-9.757	4.597
		LEM*0.45	-9.976	4.918
		LEM*0.50	-10.176	5.84

6)	0.44*LEM	LEM*0.1	-7.3761	2.377
		LEM*0.15	-7.815	2.569
		LEM*0.20	-8.2767	2.866
		LEM*0.25	-8.7149	3.238
		LEM*0.30	-9.2104	3.693
		LEM*0.35	-9.6963	4.207
		LEM*0.40	-10.416	4.769
		LEM*0.45	-11.421	5.339
		LEM*0.50	-13.061	5.862
7)	0.45*LEM	LEM*0.1	-6.9656	2.408
		LEM*0.15	-7.5214	2.589
		LEM*0.20	-8.1939	2.888
		LEM*0.25	-8.901	3.261
		LEM*0.30	-9.7519	3.715
		LEM*0.35	-10.621	4.233
		LEM*0.40	-12.047	4.799
		LEM*0.45	-13.929	5.37
		LEM*0.50	-16.847	5.897
8)	0.46*LEM	LEM*0.1	-6.3662	2.407
		LEM*0.15	-7.0583	2.603
		LEM*0.20	-7.8767	2.909
		LEM*0.25	-8.7638	3.283
		LEM*0.30	-9.8919	3.738
		LEM*0.35	-11.223	4.266
		LEM*0.40	-13.412	4.83
		LEM*0.45	-16.047	5.406
		LEM*0.50	-20.774	5.94
9)	0.465*LEM	LEM*0.1	-6.0724	2.408
		LEM*0.15	-6.801	2.611
		LEM*0.20	-7.6438	2.917
		LEM*0.25	-8.5876	3.293
		LEM*0.30	-9.7526	3.75
		LEM*0.35	-11.254	4.281
		LEM*0.40	-133.341	4.847
		LEM*0.45	-16.528	5.426
		LEM*0.50	-21.211	5.964
10)	0.466*LEM	LEM*0.1	-6.0166	2.409
		LEM*0.15	-6.1357	2.872
		LEM*0.20	-7.4376	3.109
		LEM*0.25	-9.3482	3.418
		LEM*0.30	-11.739	3.912
		LEM*0.35	-13.892	4.267
		LEM*0.40	-17.629	4.928
		LEM*0.45	-19.129	5.431
		LEM*0.50	-20.974	5.969

11)	0.467*LEM	LEM*0.1	-5.961	2.41
		LEM*0.15	-7.6232	2.872
		LEM*0.20	-9.8689	3.109
		LEM*0.25	-12.9245	3.418
		LEM*0.30	-15.542	3.912
		LEM*0.35	-18.913	4.267
		LEM*0.40	-19.948	4.928
		LEM*0.45	-20.329	5.431
		LEM*0.50	-20.675	5.974
12)	0.468*LEM	LEM*0.1	-5.9059	2.412
		LEM*0.15	-6.6485	2.872
		LEM*0.20	-9.6232	3.109
		LEM*0.25	-11.8689	3.418
		LEM*0.30	-13.9245	3.912
		LEM*0.35	-15.542	4.267
		LEM*0.40	-18.913	4.928
		LEM*0.45	-19.948	5.431
		LEM*0.50	-20.329	5.98
13)	0.469*LEM	LEM*0.1	-5.8508	2.413
		LEM*0.15	-5.8963	2.872
		LEM*0.20	-6.6485	3.109
		LEM*0.25	-9.6232	3.418
		LEM*0.30	-11.8689	3.912
		LEM*0.35	-13.9245	4.267
		LEM*0.40	-15.542	4.928
		LEM*0.45	-18.913	5.431
		LEM*0.50	-19.948	5.985
14)	0.47*LEM	LEM*0.1	-5.7959	2.415
		LEM*0.15	-5.8963	2.872
		LEM*0.20	-6.6485	3.109
		LEM*0.25	-9.6232	3.418
		LEM*0.30	-11.8689	3.912
		LEM*0.35	-13.9245	4.267
		LEM*0.40	-15.542	4.928
		LEM*0.45	-18.913	5.431
		LEM*0.50	-19.525	5.99
15)	0.471*LEM	LEM*0.1	-5.7413	2.416
		LEM*0.15	-8.8689	2.872
		LEM*0.20	-9.9245	3.109
		LEM*0.25	-10.542	3.418
		LEM*0.30	-14.913	3.912
		LEM*0.35	-16.725	4.267
		LEM*0.40	-17.946	4.928
		LEM*0.45	-18.703	5.431
		LEM*0.50	-19.127	5.995

16)	0.472*LEM	LEM*0.1	-5.687	2.417
		LEM*0.15	-7.6232	2.872
		LEM*0.20	-8.8689	3.109
		LEM*0.25	-9.9245	3.418
		LEM*0.30	-10.542	3.912
		LEM*0.35	-14.913	4.267
		LEM*0.40	-16.725	4.928
		LEM*0.45	-17.946	5.431
		LEM*0.50	-18.703	6.001
17)	0.473*LEM	LEM*0.1	-5.514	2.418
		LEM*0.15	-7.6232	2.872
		LEM*0.20	-8.8689	3.109
		LEM*0.25	-9.9245	3.418
		LEM*0.30	-10.542	3.912
		LEM*0.35	-14.913	4.267
		LEM*0.40	-16.725	4.928
		LEM*0.45	-17.946	5.431
		LEM*0.50	-18.369	6.006
18)	0.474*LEM	LEM*0.1	-5.479	2.419
		LEM*0.15	-6.6485	2.872
		LEM*0.20	-7.6232	3.109
		LEM*0.25	-8.8689	3.418
		LEM*0.30	-9.9245	3.912
		LEM*0.35	-10.542	4.267
		LEM*0.40	-14.913	4.928
		LEM*0.45	-16.725	5.431
		LEM*0.50	-17.946	6.011
19)	0.475*LEM	LEM*0.1	-5.5266	2.421
		LEM*0.15	-7.251	2.562
		LEM*0.20	-8.339	2.98
		LEM*0.25	-9.718	3.339
		LEM*0.30	-11.615	3.927
		LEM*0.35	-12.193	4.413
		LEM*0.40	-14.981	4.971
		LEM*0.45	-15.765	5.465
		LEM*0.50	-17.53	6.017
20)	0.476*LEM	LEM*0.1	-5.312	2.421
		LEM*0.15	-6.6485	2.562
		LEM*0.20	-7.6232	2.98
		LEM*0.25	-8.8689	3.339
		LEM*0.30	-9.9245	3.927
		LEM*0.35	-10.542	4.413
		LEM*0.40	-14.913	4.971
		LEM*0.45	-16.725	5.465
		LEM*0.50	-17.122	6.022

21)	0.477*LEM	LEM*0.1	-5.296	2.422
		LEM*0.15	-5.9836	2.562
		LEM*0.20	-6.6485	2.98
		LEM*0.25	-7.6232	3.339
		LEM*0.30	-8.8689	3.927
		LEM*0.35	-9.9245	4.413
		LEM*0.40	-10.542	4.971
		LEM*0.45	-14.913	5.465
		LEM*0.50	-16.725	6.028
22)	0.478*LEM	LEM*0.1	-5.137	2.422
		LEM*0.15	-5.9836	2.562
		LEM*0.20	-6.6485	2.98
		LEM*0.25	-7.6232	3.339
		LEM*0.30	-8.8689	3.927
		LEM*0.35	-9.9245	4.413
		LEM*0.40	-10.542	4.971
		LEM*0.45	-14.913	5.465
		LEM*0.50	-16.339	6.033
23)	0.479*LEM	LEM*0.1	-5.088	2.424
		LEM*0.15	-5.9836	2.562
		LEM*0.20	-6.6485	2.98
		LEM*0.25	-7.6232	3.339
		LEM*0.30	-8.8689	3.927
		LEM*0.35	-9.9245	4.413
		LEM*0.40	-10.542	4.971
		LEM*0.45	-14.913	5.465
		LEM*0.50	-15.965	6.039
24)	0.48*LEM	LEM*0.1	-5.275	2.43
		LEM*0.15	-6.6485	2.562
		LEM*0.20	-7.6232	2.98
		LEM*0.25	-8.8689	3.339
		LEM*0.30	-9.9245	3.927
		LEM*0.35	-10.542	4.413
		LEM*0.40	-14.913	4.971
		LEM*0.45	-14.782	5.487
		LEM*0.50	-15.603	6.045
25)	0.481*LEM	LEM*0.1	-4.967	2.426
		LEM*0.15	-5.8963	2.562
		LEM*0.20	-6.6485	2.98
		LEM*0.25	-7.6232	3.339
		LEM*0.30	-8.8689	3.927
		LEM*0.35	-9.9245	4.413
		LEM*0.40	-10.542	4.971
		LEM*0.45	-14.913	5.487
		LEM*0.50	-15.252	6.05

26)	0.482*LEM	LEM*0.1	-4.874	2.427
		LEM*0.15	-5.0606	2.562
		LEM*0.20	-5.8963	2.98
		LEM*0.25	-6.6485	3.339
		LEM*0.30	-7.6232	3.927
		LEM*0.35	-8.8689	4.413
		LEM*0.40	-9.9245	4.971
		LEM*0.45	-10.542	5.487
		LEM*0.50	-14.913	6.056
27)	0.485*LEM	LEM*0.1	-5.0174	2.423
		LEM*0.15	-5.8361	2.671
		LEM*0.20	-6.5601	2.936
		LEM*0.25	-7.4792	3.354
		LEM*0.30	-8.6856	3.791
		LEM*0.35	-9.1327	4.186
		LEM*0.40	-11.93	4.914
		LEM*0.45	-12.178	5.412
		LEM*0.50	-13.963	6.073
28)	0.49*LEM	LEM*0.1	-4.788	2.427
		LEM*0.15	-5.0606	2.671
		LEM*0.20	-5.8963	2.936
		LEM*0.25	-6.6485	3.354
		LEM*0.30	-7.6232	3.791
		LEM*0.35	-8.8689	4.186
		LEM*0.40	-9.9245	4.914
		LEM*0.45	-10.542	5.412
		LEM*0.50	-12.408	6.097
29)	0.495*LEM	LEM*0.1	-4.5751	2.436
		LEM*0.15	-5.0606	2.671
		LEM*0.20	-5.8963	2.936
		LEM*0.25	-6.6485	3.354
		LEM*0.30	-7.6232	3.791
		LEM*0.35	-8.8689	4.186
		LEM*0.40	-9.9245	4.914
		LEM*0.45	-10.542	5.412
		LEM*0.50	-11.247	6.125
30)	0.5*LEM	LEM*0.1	-4.3769	2.44
		LEM*0.15	-5.0606	2.655
		LEM*0.20	-5.8963	2.958
		LEM*0.25	-6.6485	3.358
		LEM*0.30	-7.6232	3.816
		LEM*0.35	-8.8689	4.353
		LEM*0.40	-9.9245	4.959
		LEM*0.45	-10.542	5.566
		LEM*0.50	-10.251	6.154

Conclusion:

From the observation Table we can come to the conclusion that when there is

Variation in Height(H):

From 0.35*Lam -0.465*Lam: s11 increases more negatively
Gain increases

From 0.465*Lam -0.5*Lam: s11 decreases more negatively
Gain increases

Variation in Distance(D):

From 0.1*Lam -0.5*Lam: s11 increases more negatively
Gain increases

To get better results, we take
Height (h)=lam*0.414
Distance(d)=lam*0.5

After Taking This we got radiation pattern as Broadside array.