



**Department of Electronics & Telecommunication Engineering**

**CLASS: B.E. E &TC**

**SUBJECT: RMT**

**EXPT. NO.: 2**

**DATE:**

**Roll No.: 42428**

**TITLE** : Design, simulate and compare performance of microwave dipole antennas of length  $2\lambda$ ,  $\lambda$ ,  $\lambda/2$  and  $\lambda/4$ .

**PREREQUISITES:**

1. Half Power Beam Width
2. First Null Beam width
3. Reflection coefficient
4. Standing wave ratio

**OBJECTIVE** : To study various antenna parameters like radiation pattern, return loss, impedance, Directivity, gain and beam width so as to get a thorough understanding of an antenna.

**APPARATUS** : Any EM Software

**SPECIFICATION** :  $f=600*10^6$  Hz

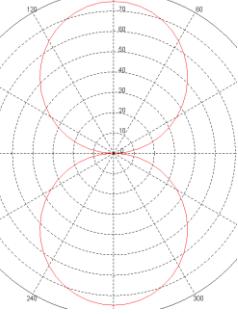
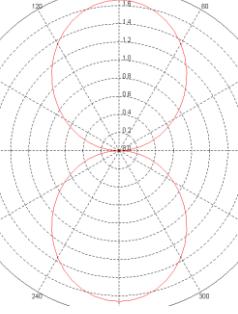
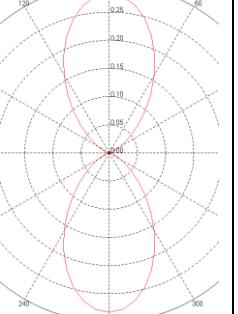
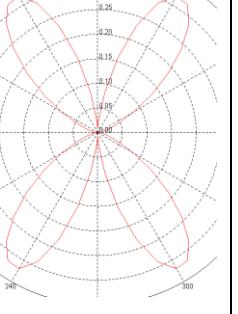
**OBSERVATIONS :**

Structure (Length of an antenna)  
Return Loss  
VSWR  
Impedance  
Directivity  
Gain  
Radiation Pattern  
HPBW of E-Plane  
HPBW of H-Plane



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### COMPARISON:

Antenna Length Antenna Parameters	$\lambda/4$	$\lambda/2$	$\lambda$	$2*\lambda$
Structure(Dipole)	Quarter Wavelength	Half Wavelength	Wavelength	Double Wavelength
Return Loss	-0.1126 dB	-15.2798 dB	-0.2372 dB	-0.2981 dB
VSWR	660.57	1.41721	73.4107	58.3372
Impedance	15.3077-j709.123 ohm	70.8354-j0.942188 ohm	3040.72-j1383.71 ohm	2549.18 -j967.975 ohm
Directivity	1.52	1.64	2.45	2.48
Gain	1.52	1.64	2.45	2.48
Radiation Pattern	 Apple Shaped (0.07454 V)	 Apple Shaped (1.6607 V)	 Apple Shaped (0.2806 V)	 Hour Glass Shaped (0.3204 V)
HPBW of E-Plane	86.809 degrees	78.36383 degrees	48.4957 degrees	26.25065 degrees
HPBW of H-Plane	360 degrees	360 degrees	360 degrees	360 degrees

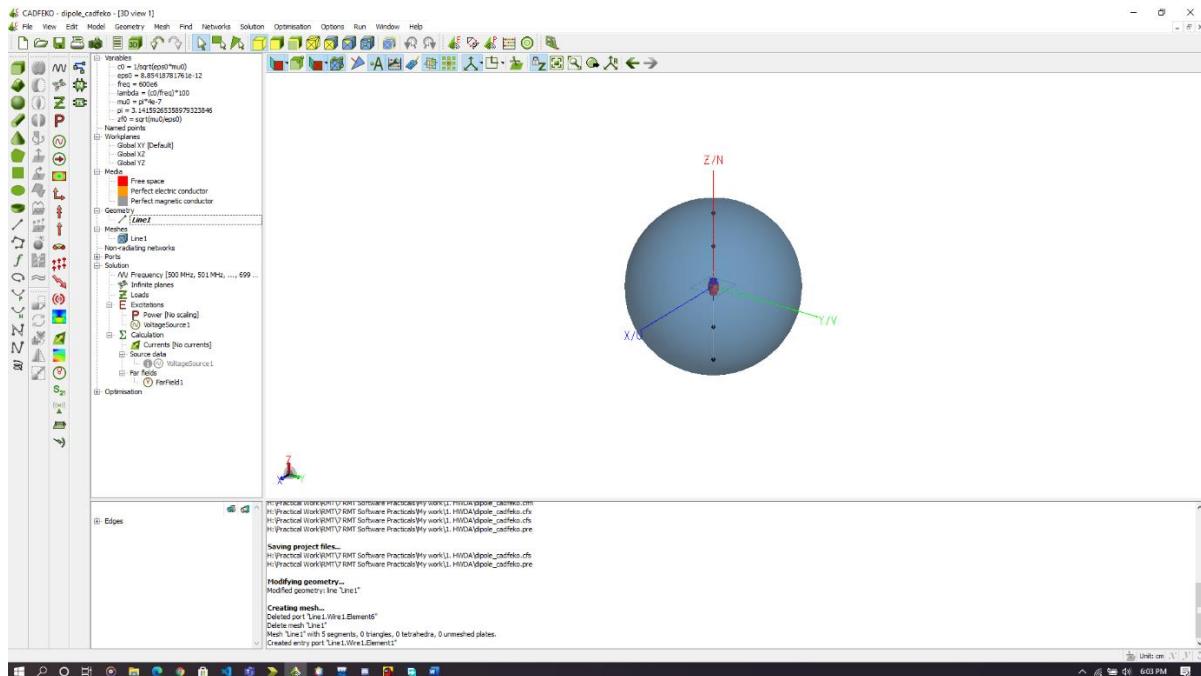
### GRAPHS OF ALL ANTENNAS:

Plot the graphs of all parameters by using CAD-FEKO software and compare **dipole antennas of length  $\lambda/4$ ,  $\lambda/2$ ,  $\lambda$  and  $2\lambda$** . antenna with respect to all parameters.



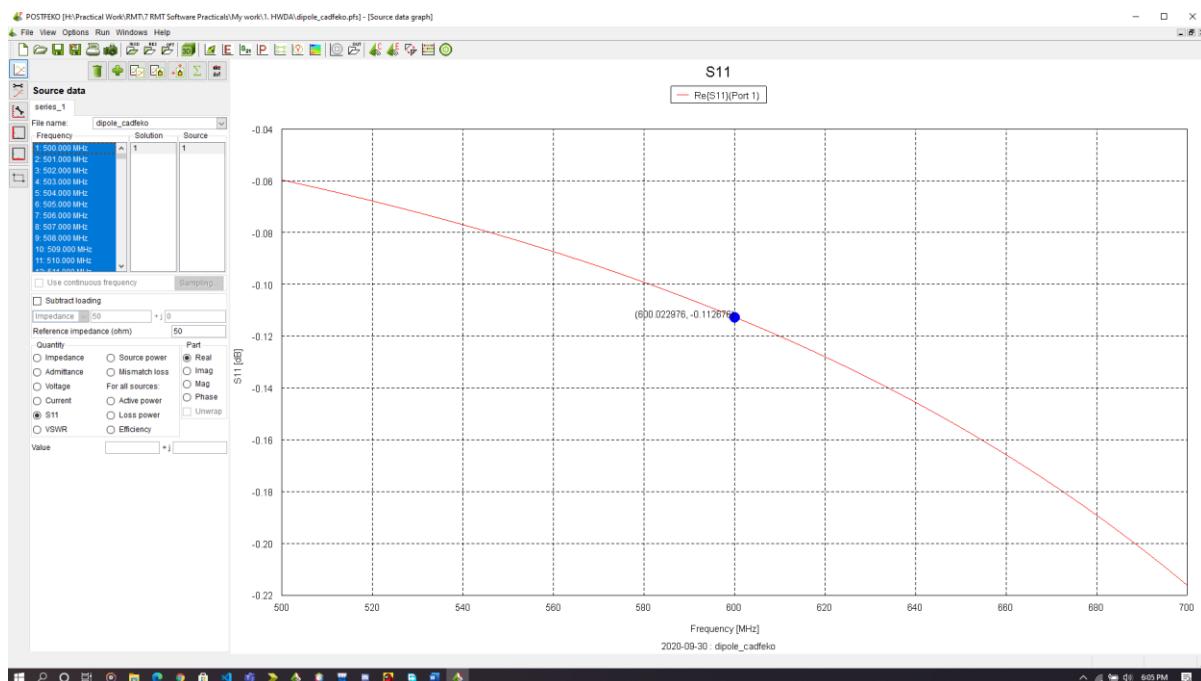
## λ/4 antenna

### Structure of Lambda by 4 antenna ( λ/4)



### Return Loss of Lambda by 4 antenna ( λ/4)

At freq=600MHz,  $s11 = 0.987122 - j0.139833$

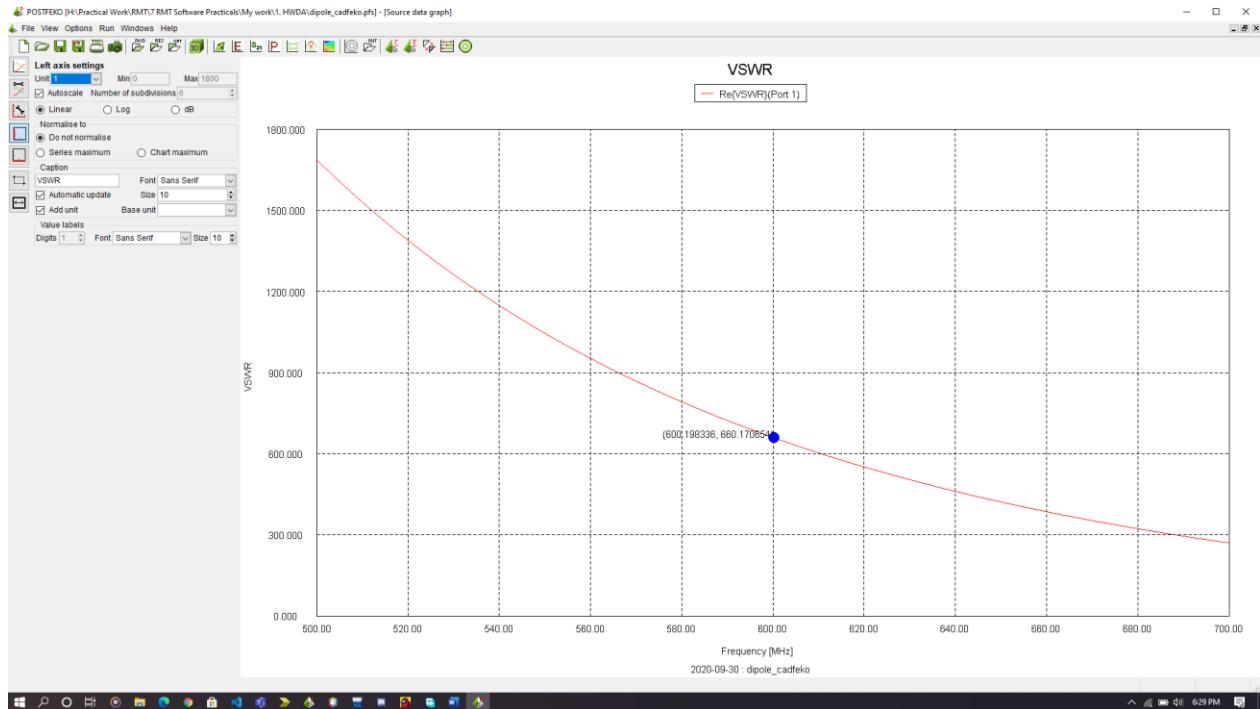




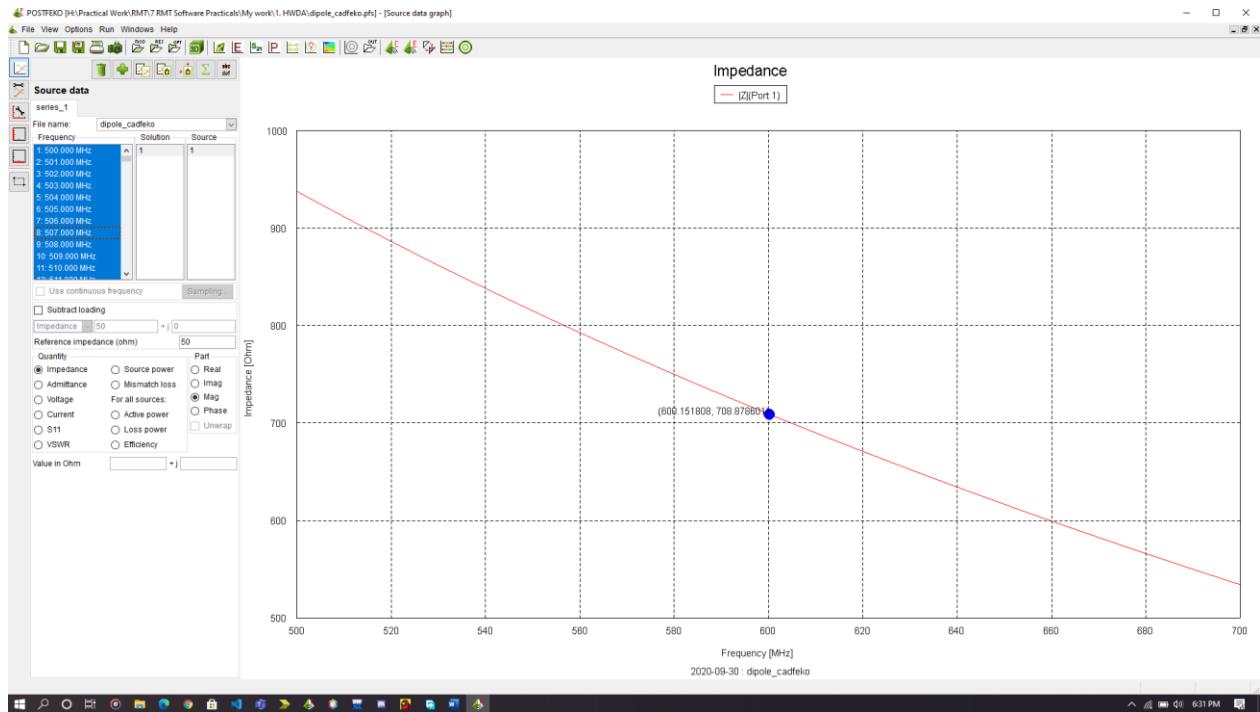
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VSWR of Lambda by 4 antenna ( $\lambda/4$ )

At freq=600MHz, VSWR=660.57

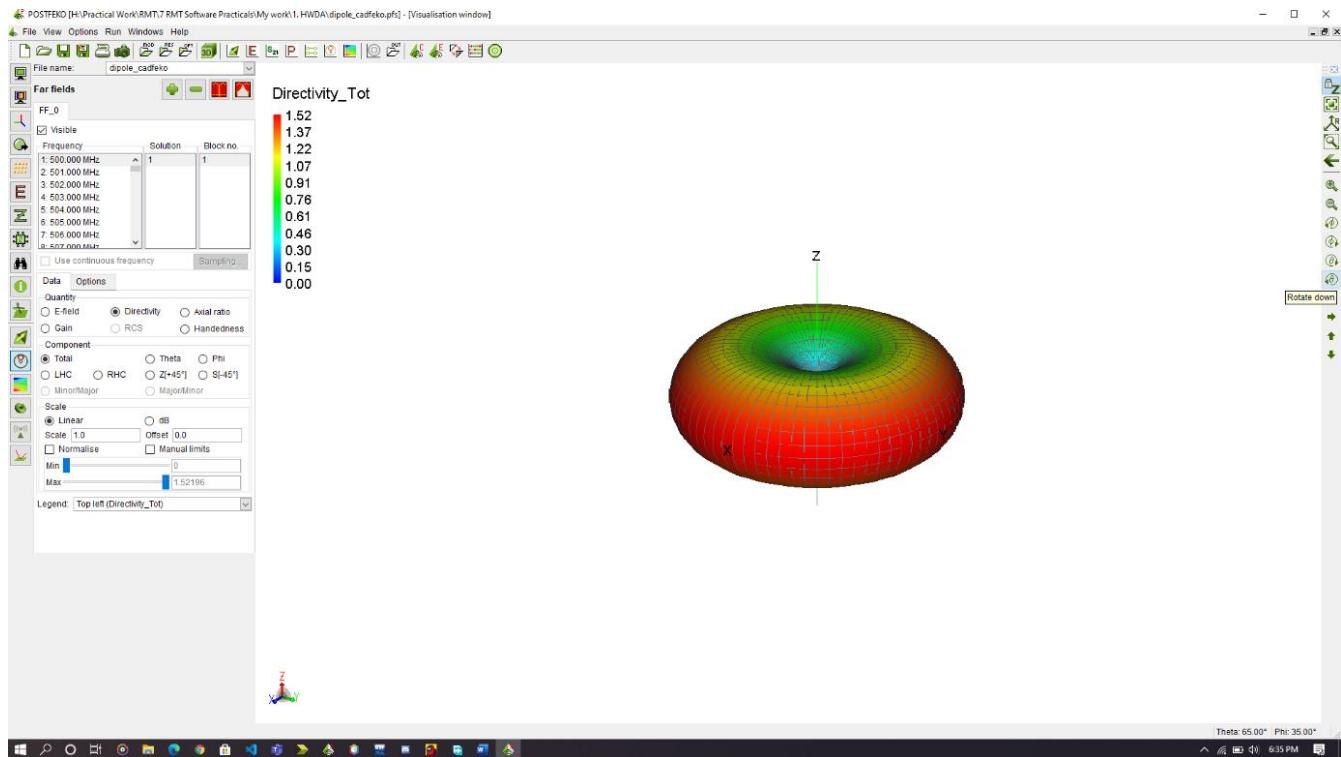
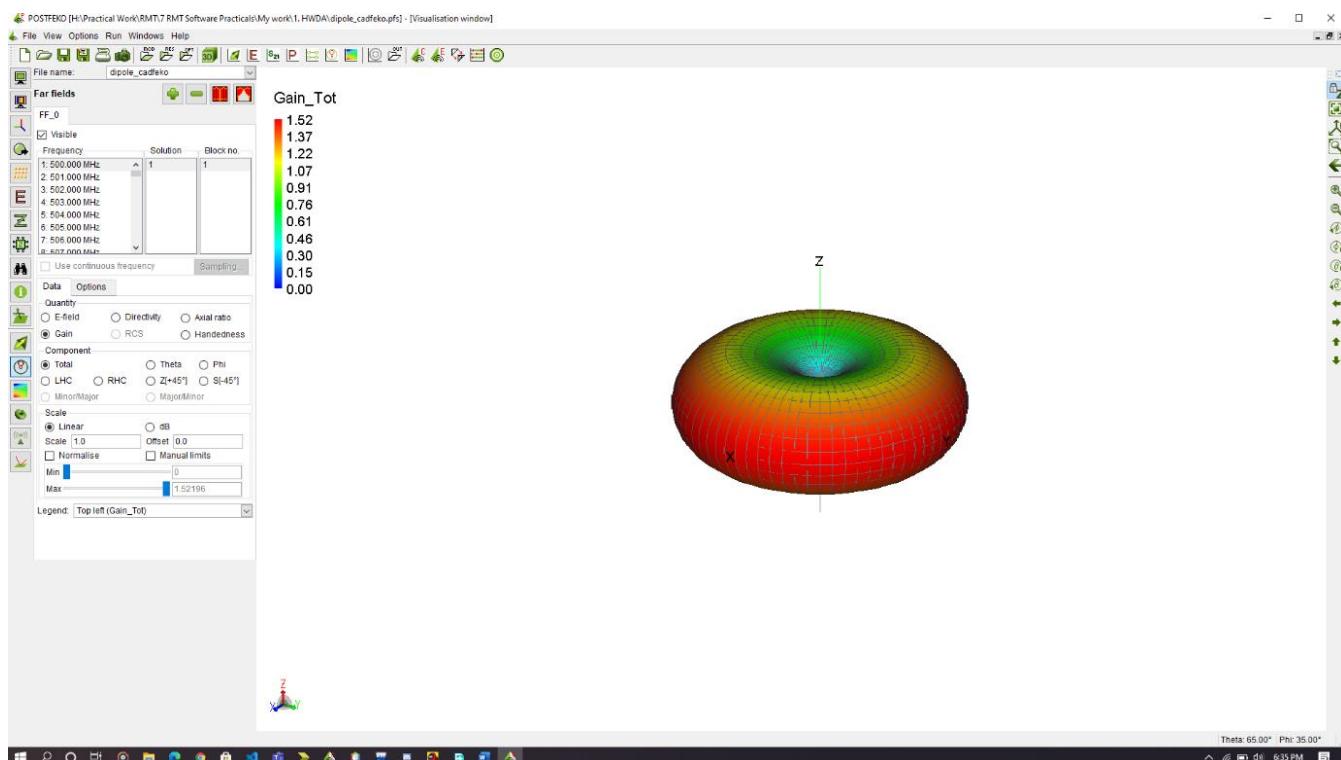
Impedance of Lambda by 4 antenna ( $\lambda/4$ )

At freq=600MHz, Z=15.3077-j709.123 ohm



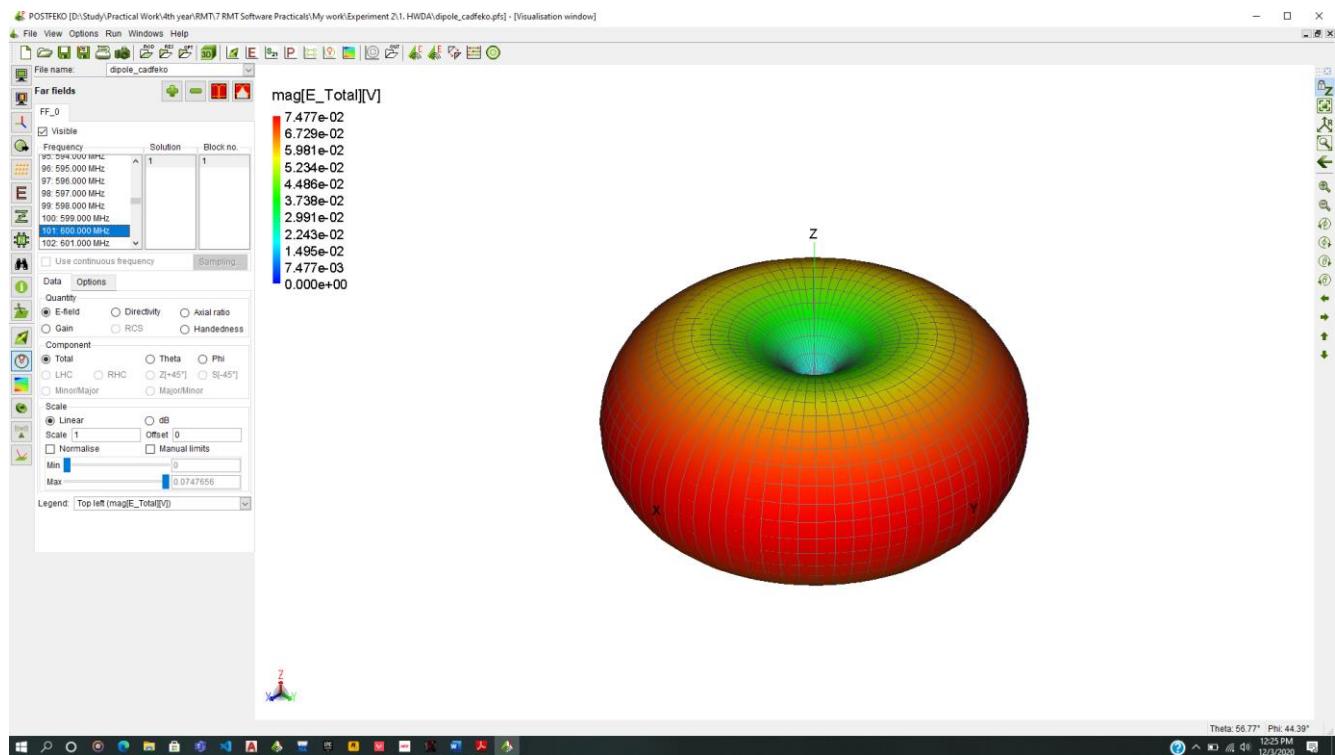


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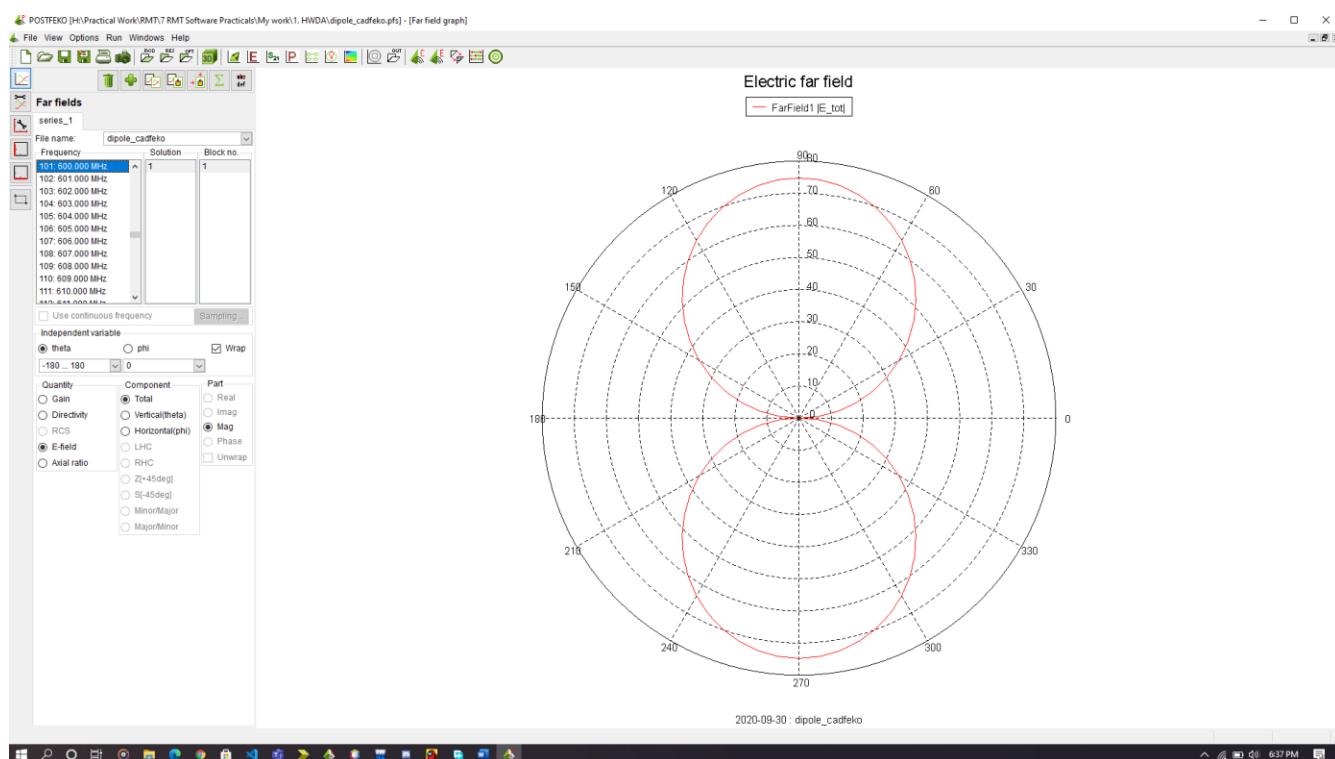
Directivity of Lambda by 4 antenna ( $\lambda/4$ )Gain of Lambda by 4 antenna ( $\lambda/4$ )



### 3-D Radiation Pattern of $\lambda/4$ antenna

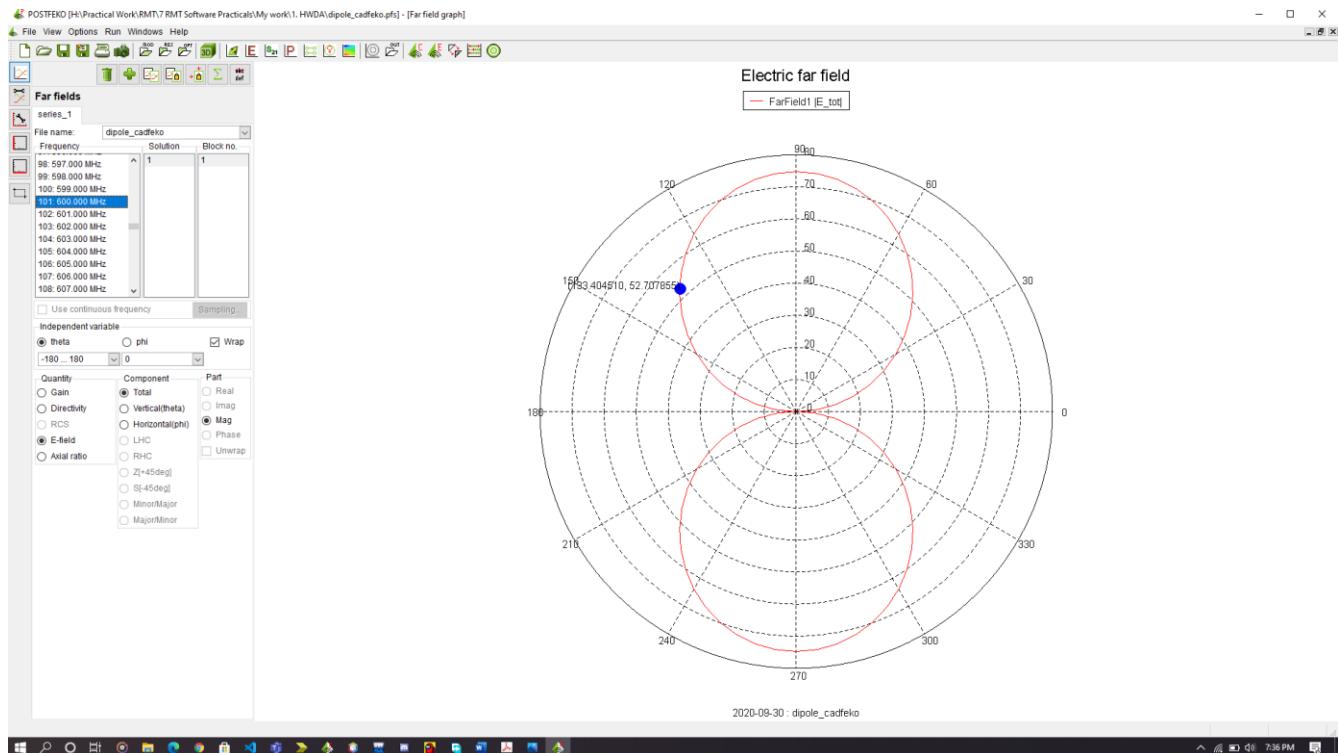
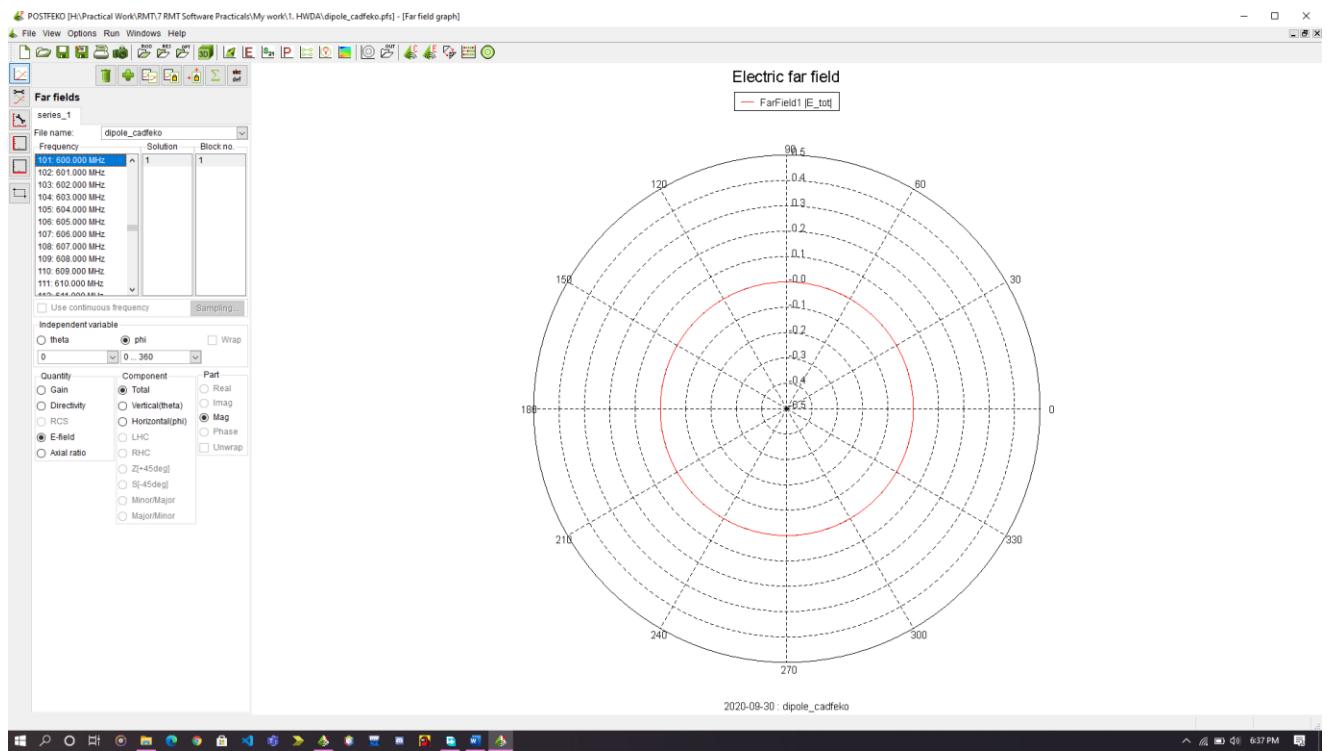


### 2-D(E-Plane Radiation Pattern) of ( $\lambda/4$ )





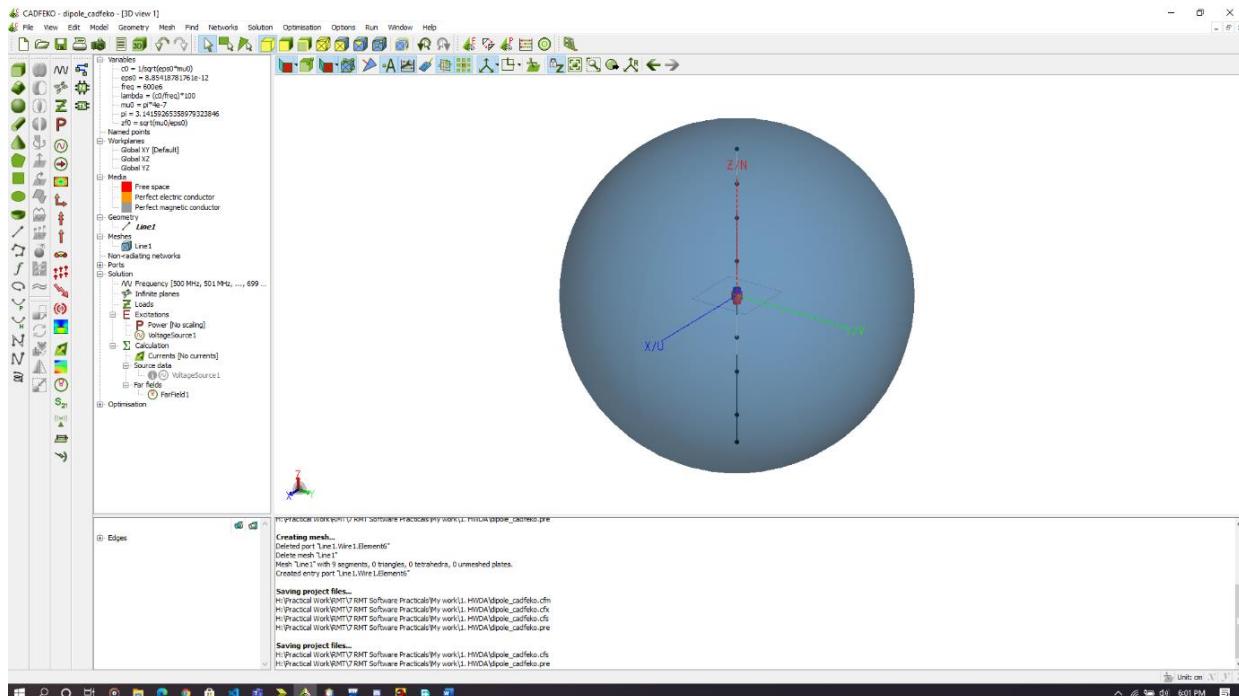
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Beamwidth (E-Plane Radiation Pattern) of ( $\lambda/4$ )2-D(H-Plane Radiation Pattern) of ( $\lambda/4$ )



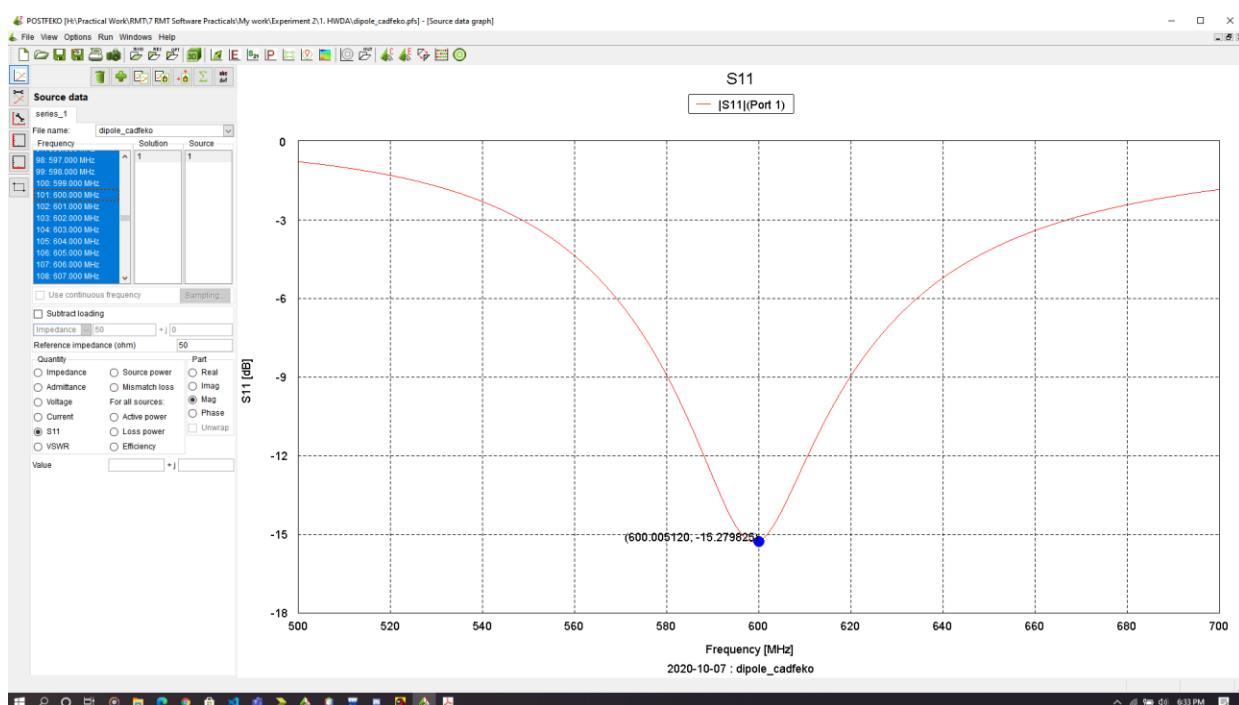
## Half wavelength dipole antenna(HWDA)

### Structure of HWDA ( $\lambda/2$ )



### Return Loss of HWDA ( $\lambda/2$ )

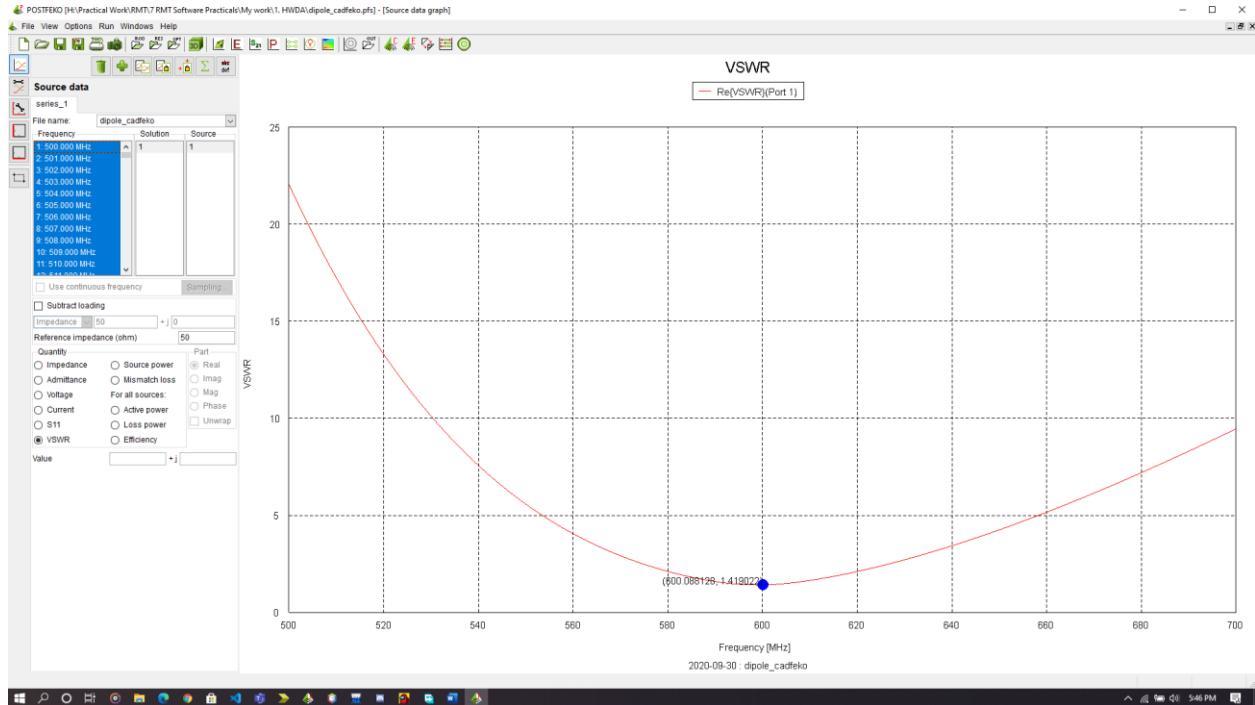
At freq=600MHz,  $S_{11} = 0.172479 - j0.00645242$



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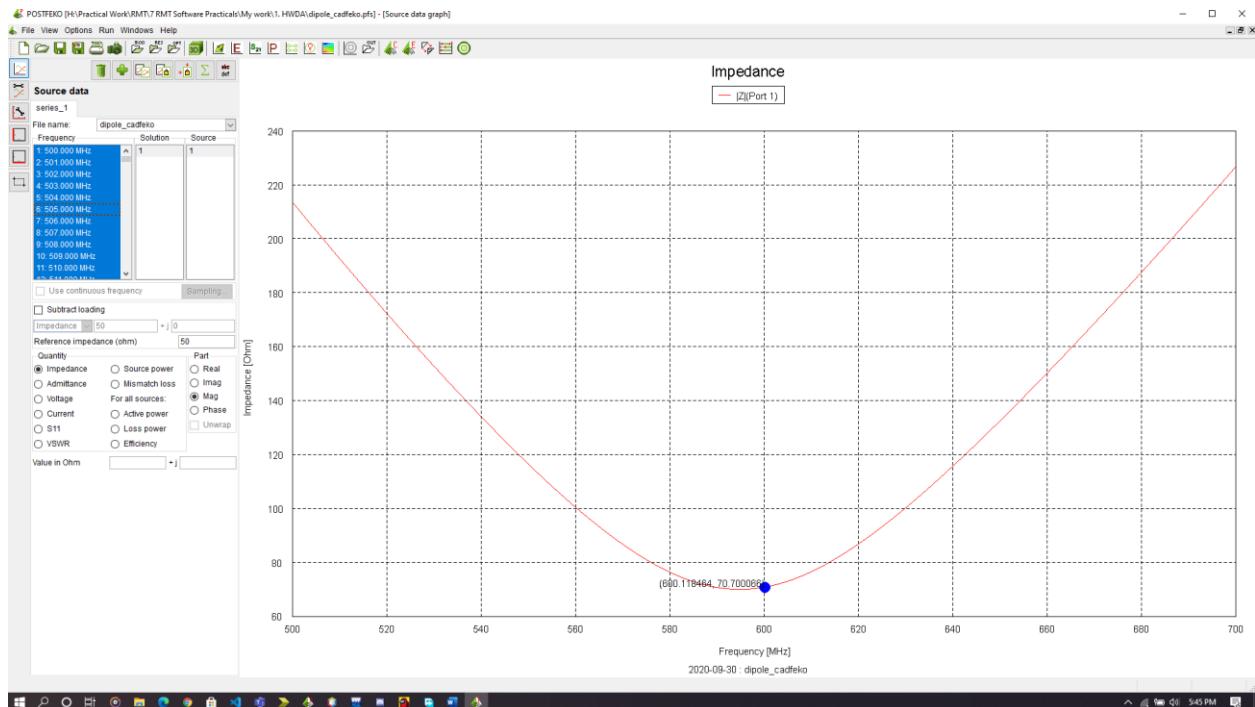
### VSWR of HWDA ( $\lambda/2$ )

At freq=600MHz, VSWR=1.41721



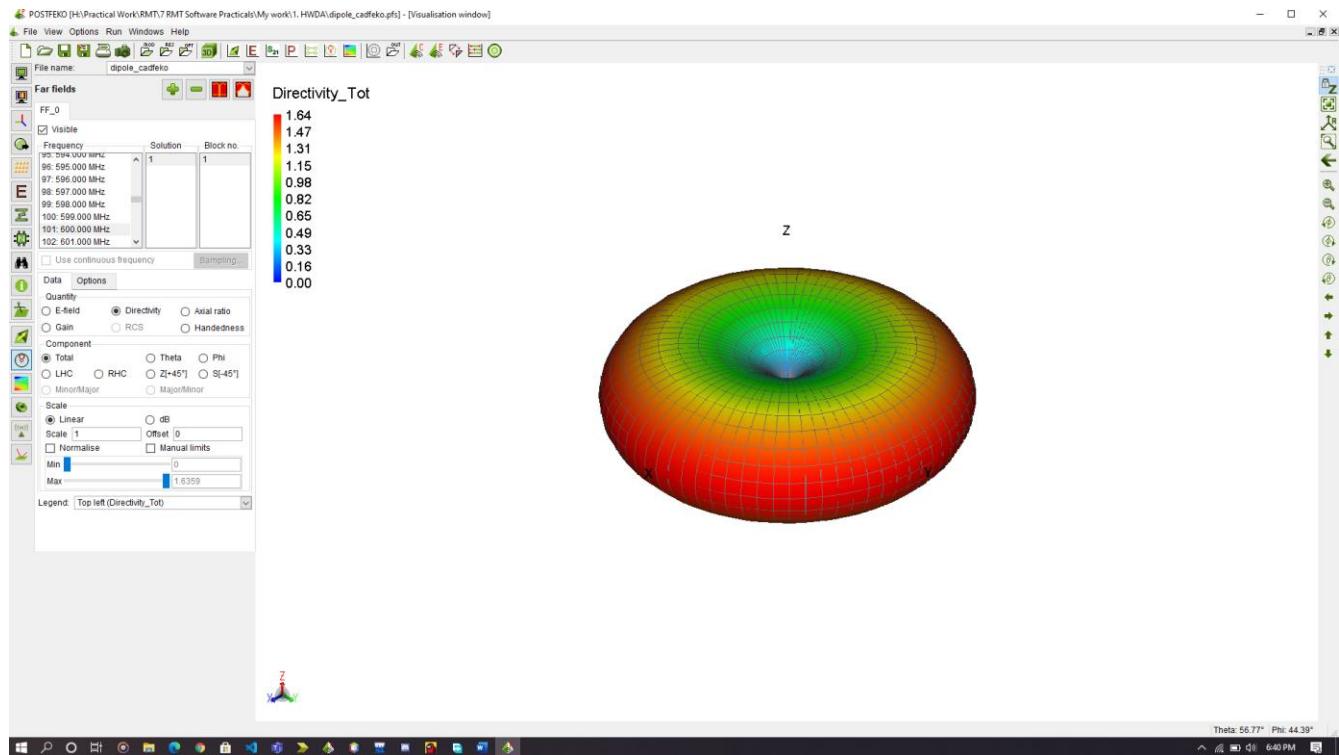
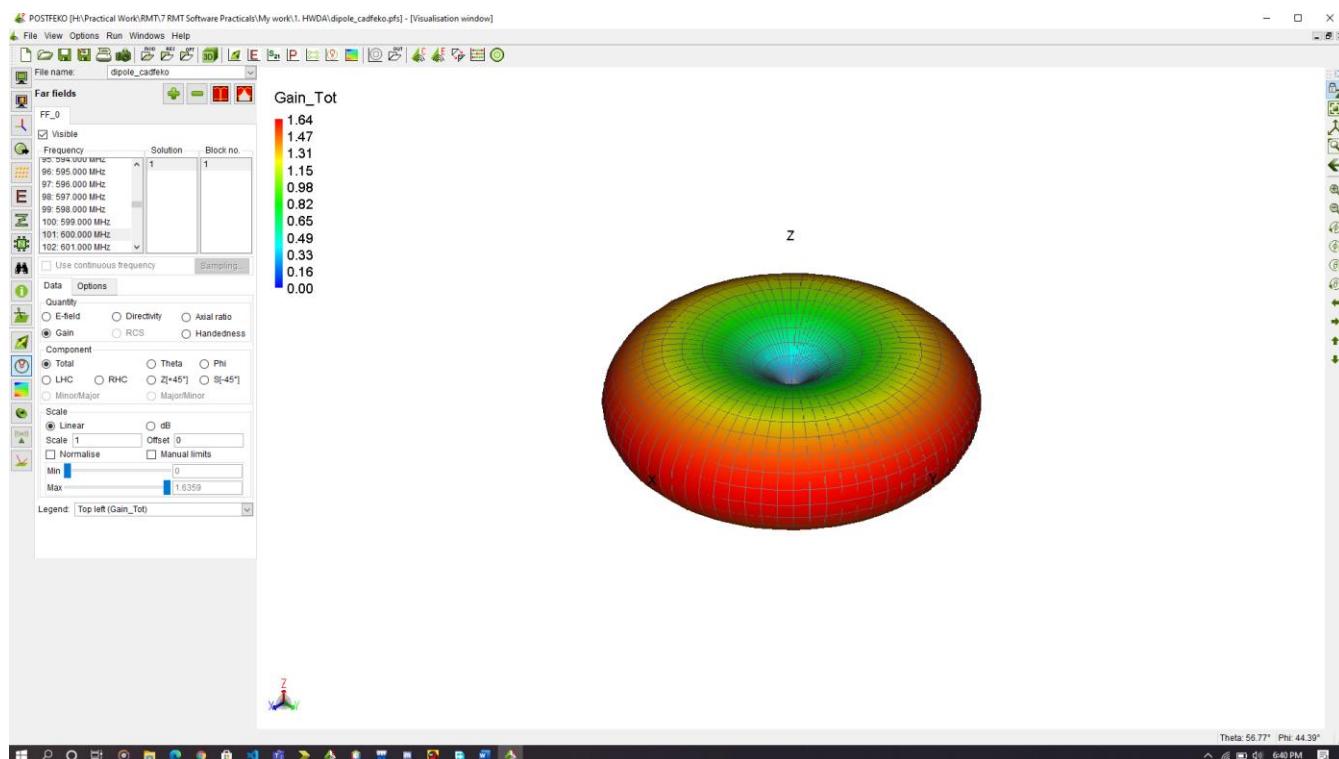
### Impedance of HWDA ( $\lambda/2$ )

At freq=600MHz, Z=70.8354-j0.942188 ohm





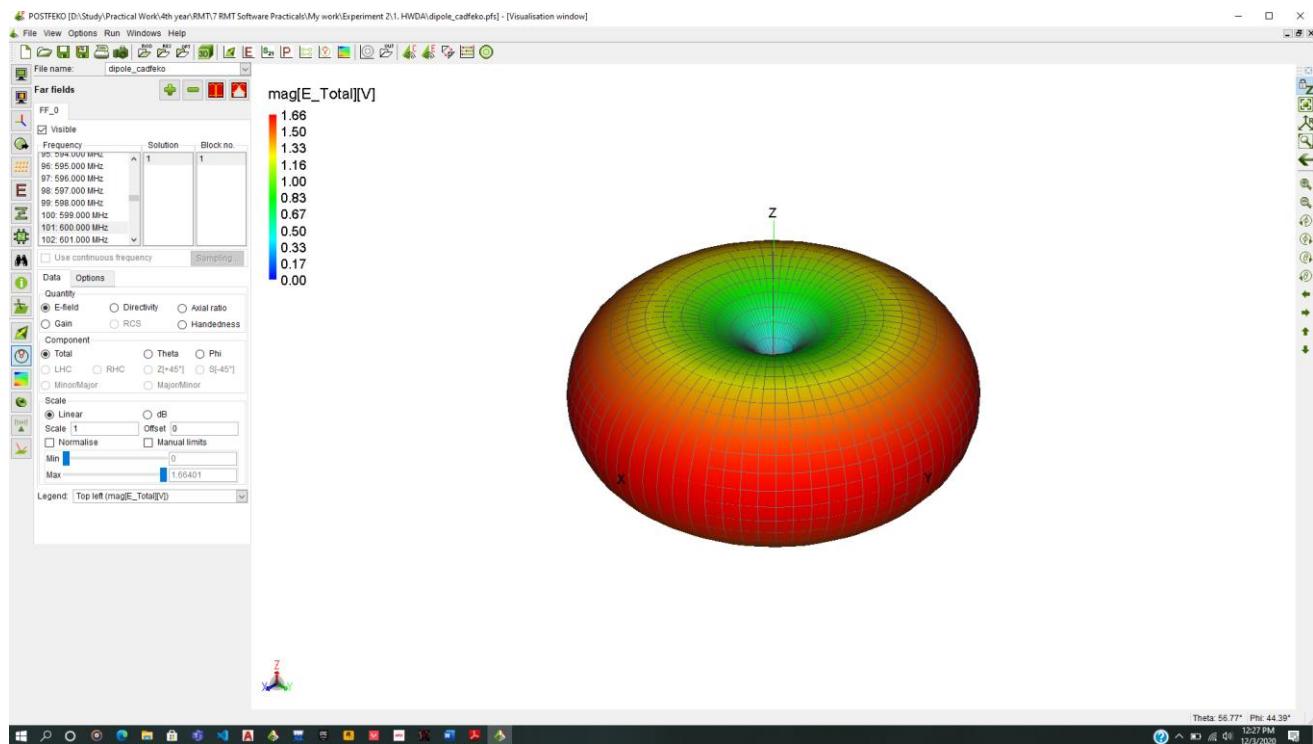
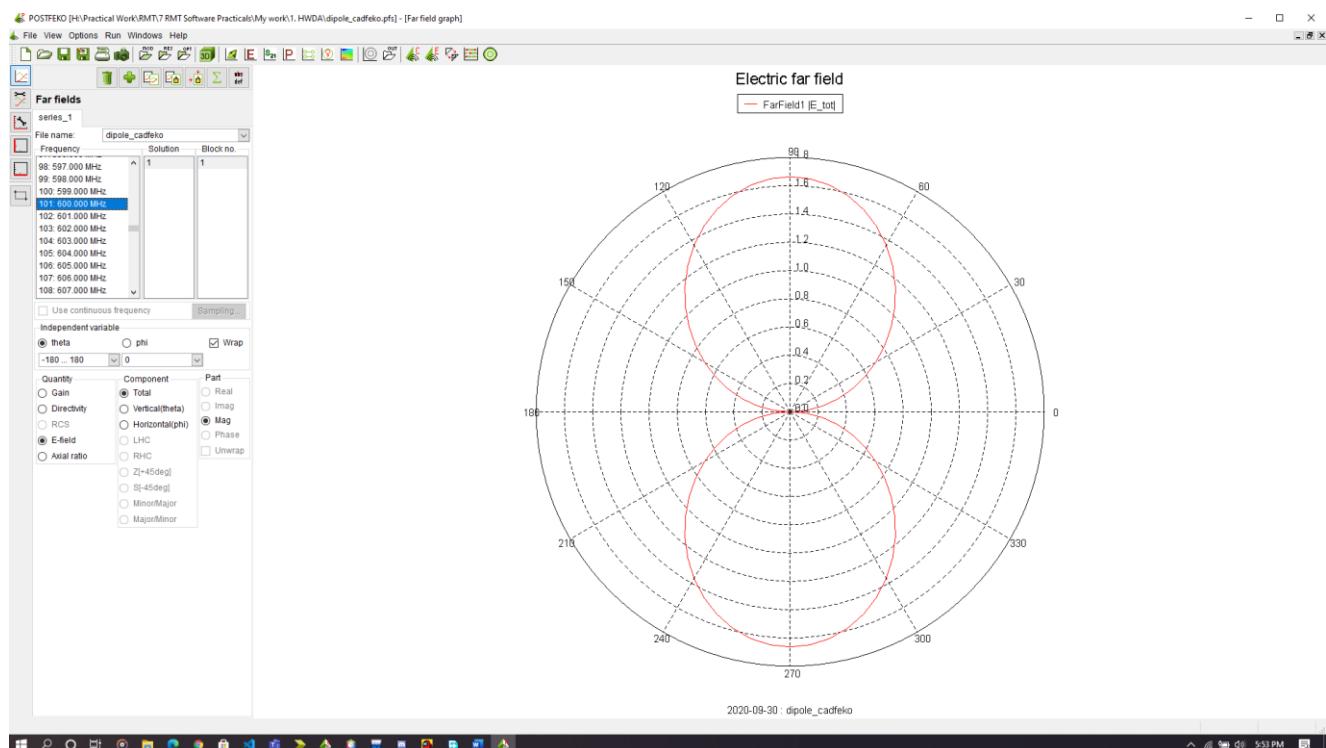
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Directivity of HWDA ( $\lambda/2$ )Gain of HWDA ( $\lambda/2$ )



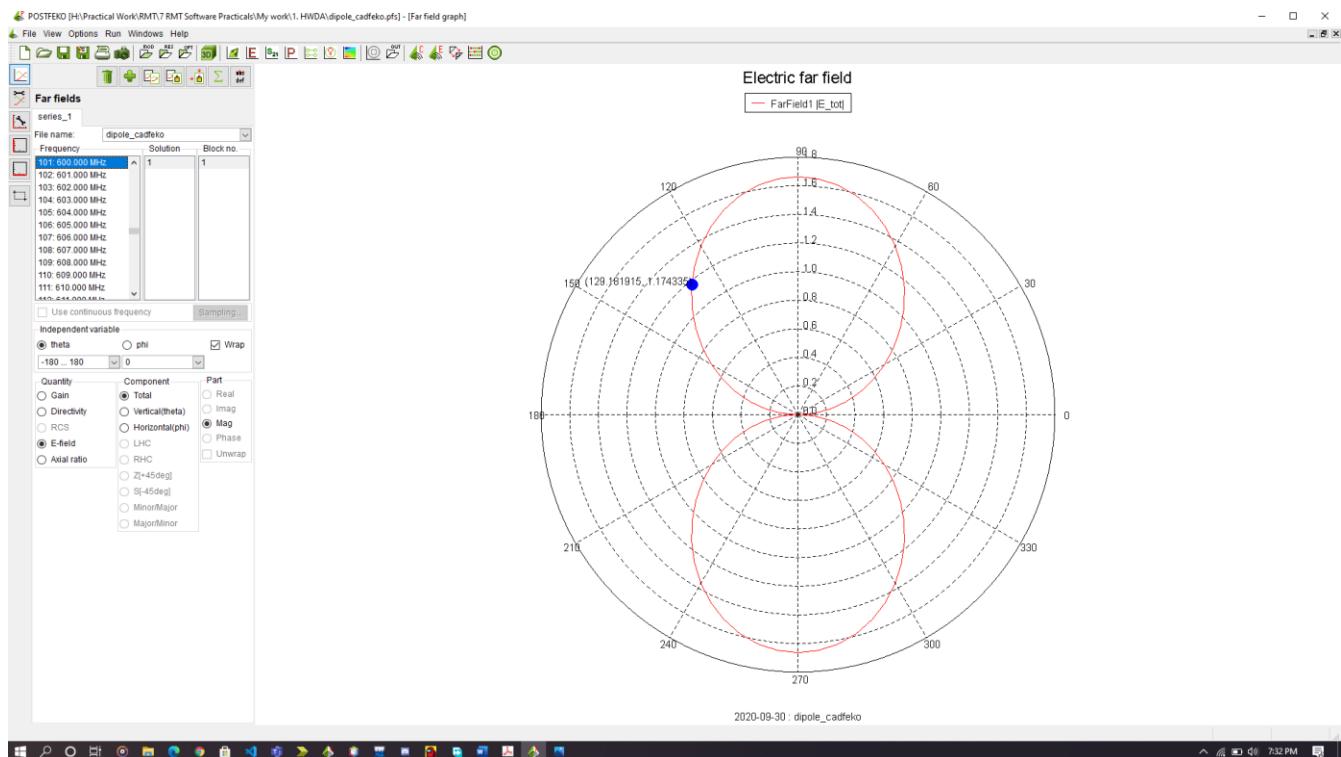
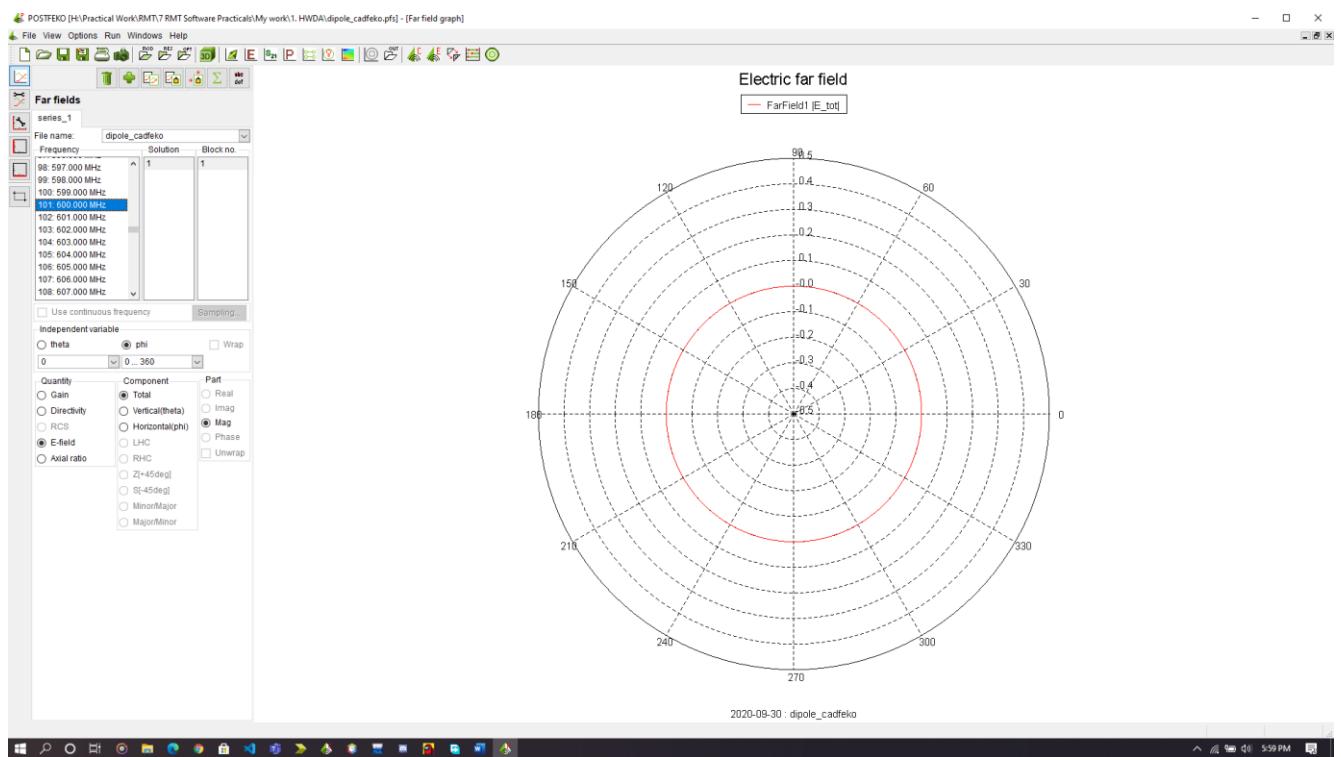
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## 3-D Radiation Pattern of HWDA

2-D(E-Plane Radiation Pattern) of ( $\lambda/2$ )



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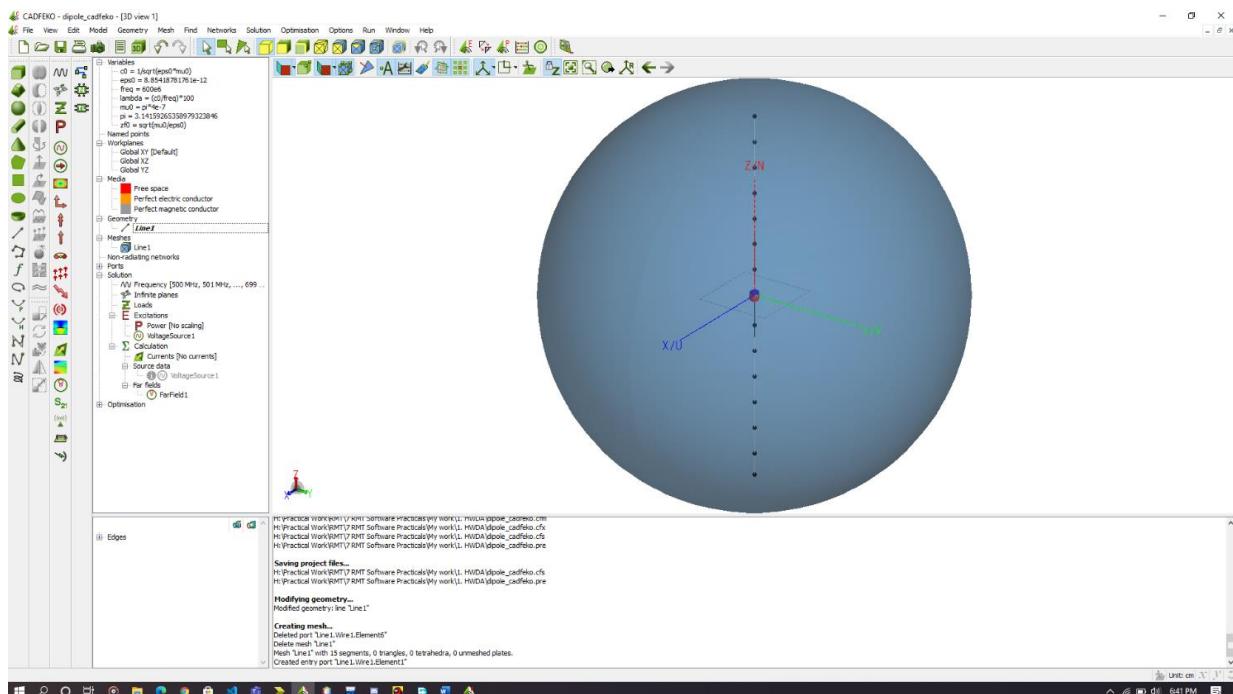
Beamwidth (E-Plane Radiation Pattern) of ( $\lambda / 2$ )2-D(H-Plane Radiation Pattern) of ( $\lambda / 2$ )



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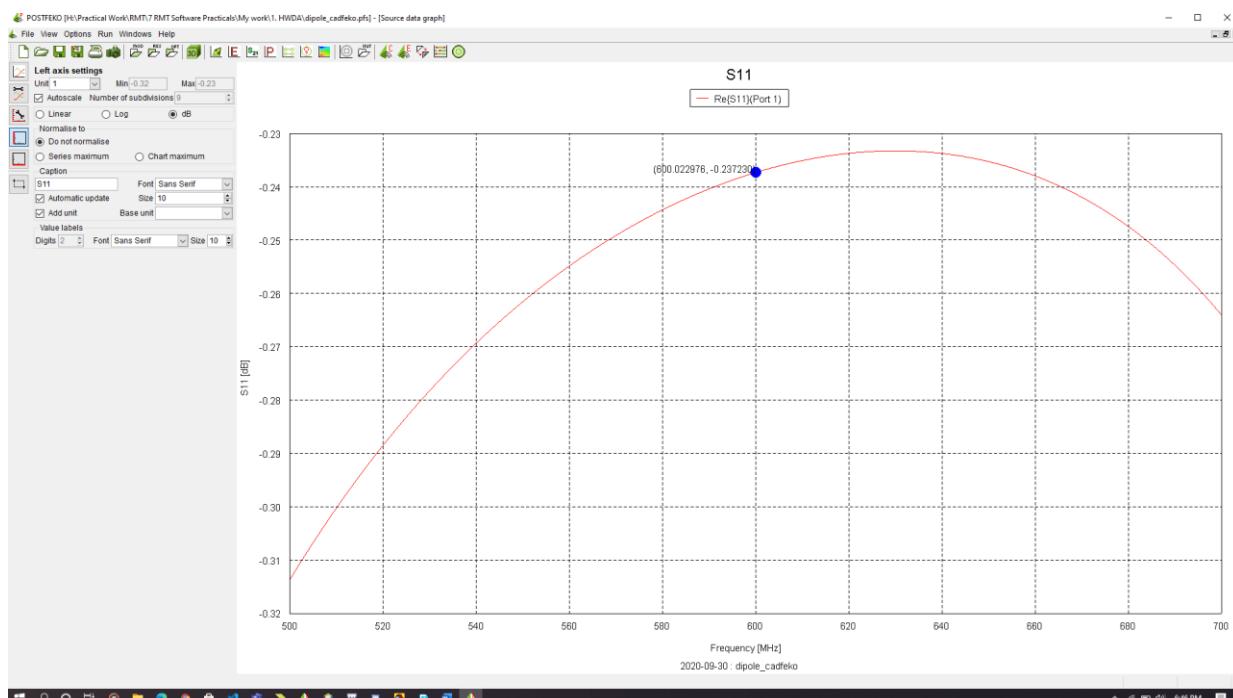
## λ antenna

### Structure of Lambda antenna ( $\lambda$ )



### Return Loss of Lambda antenna ( $\lambda$ )

At freq=600MHz,  $s11 = 0.973047 - j0.0120667$

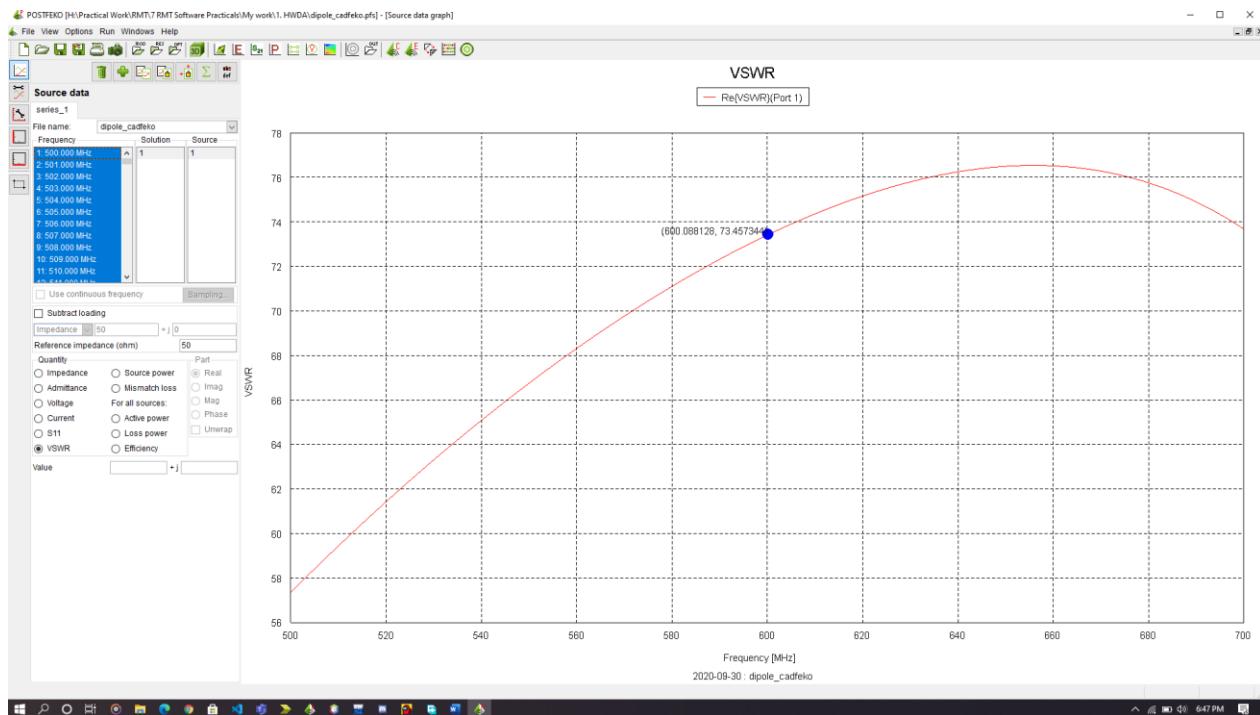




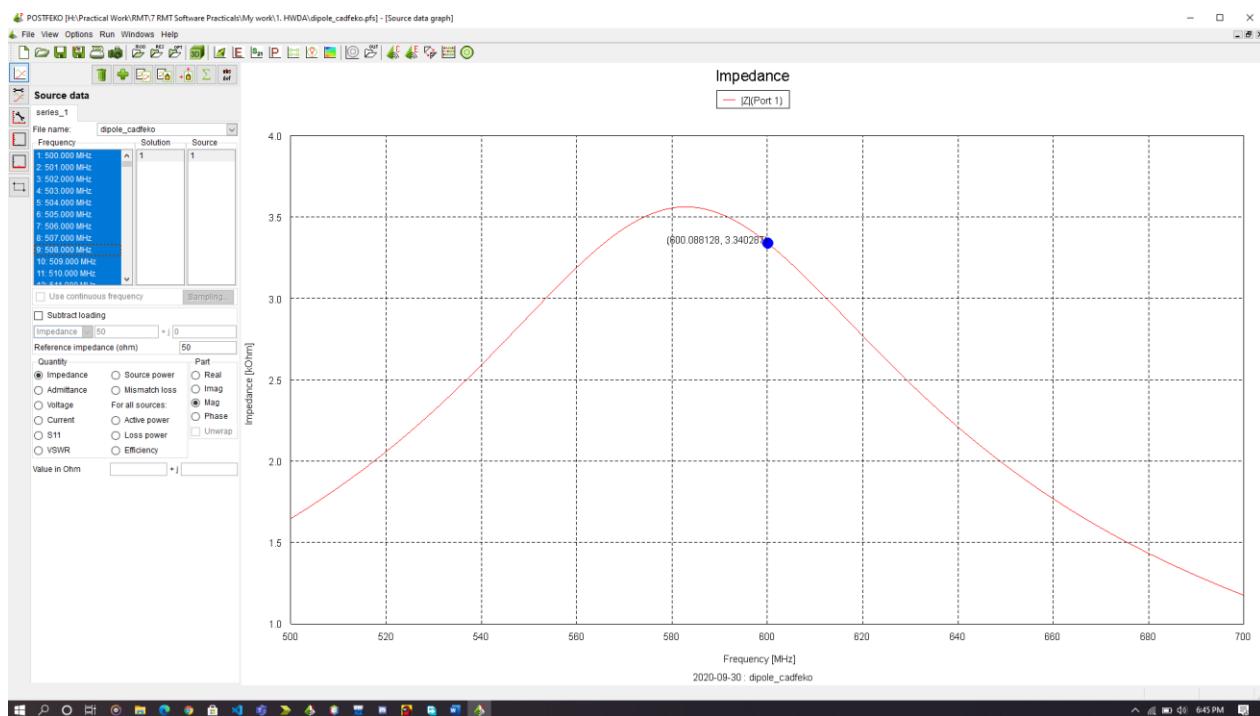
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VSWR of Lambda antenna ( $\lambda$ )

At freq=600MHz, VSWR=73.4107

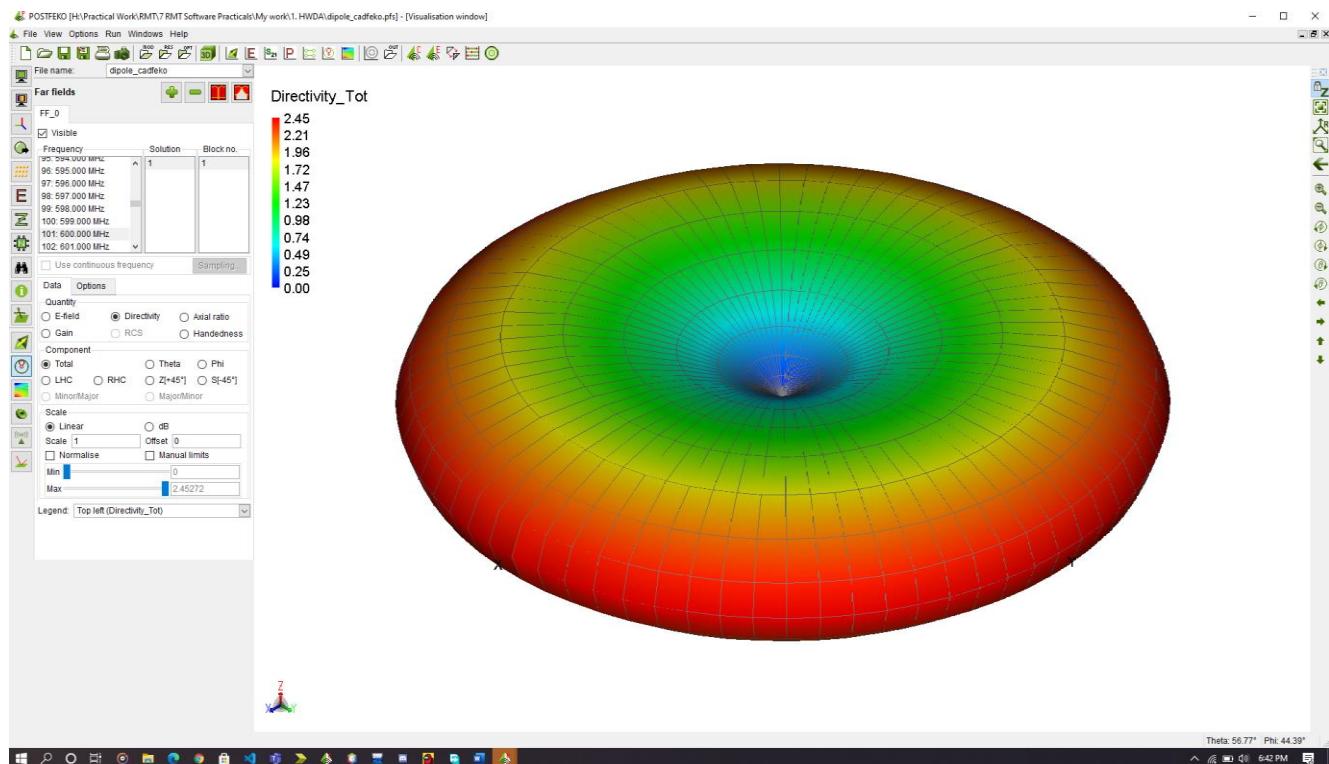
Impedance of Lambda antenna ( $\lambda$ )

At freq=600MHz, Z=3040.72-j1383.71 ohm

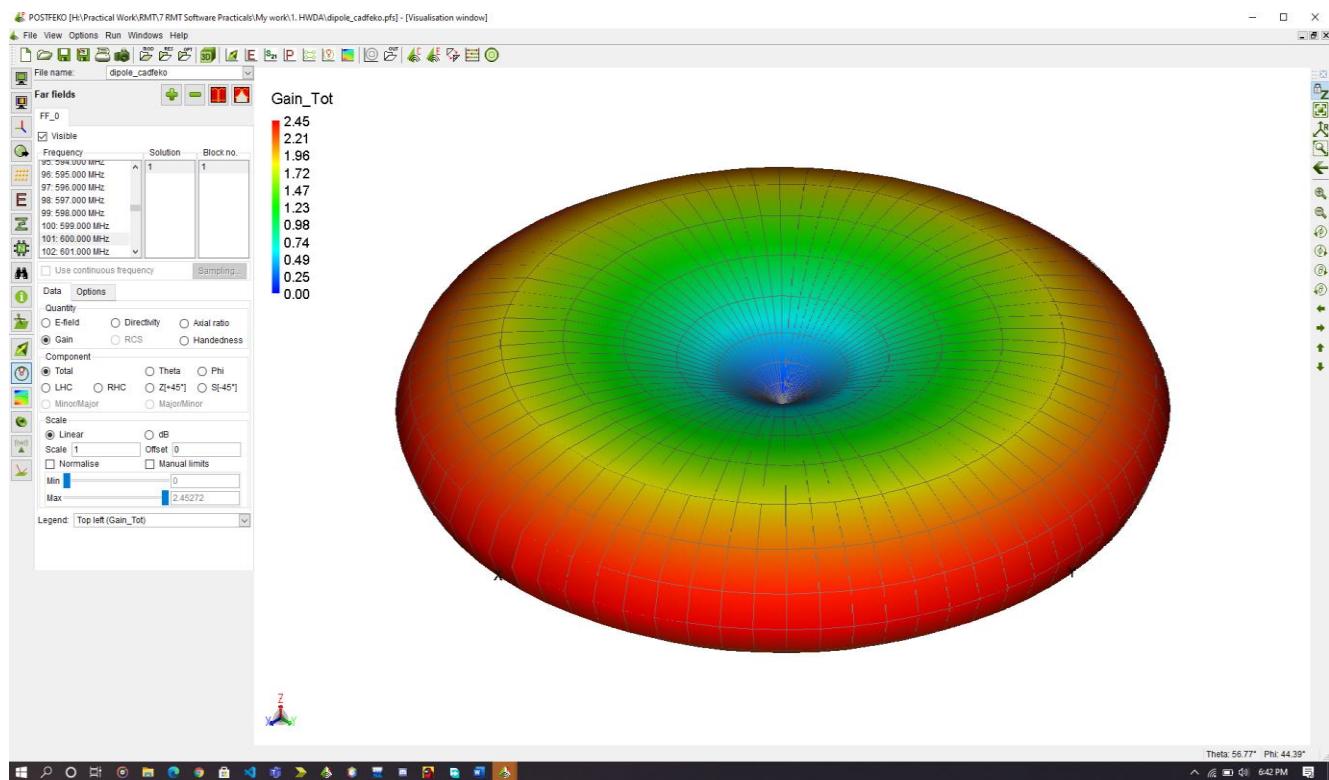


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### Directivity of Lambda antenna ( $\lambda$ )

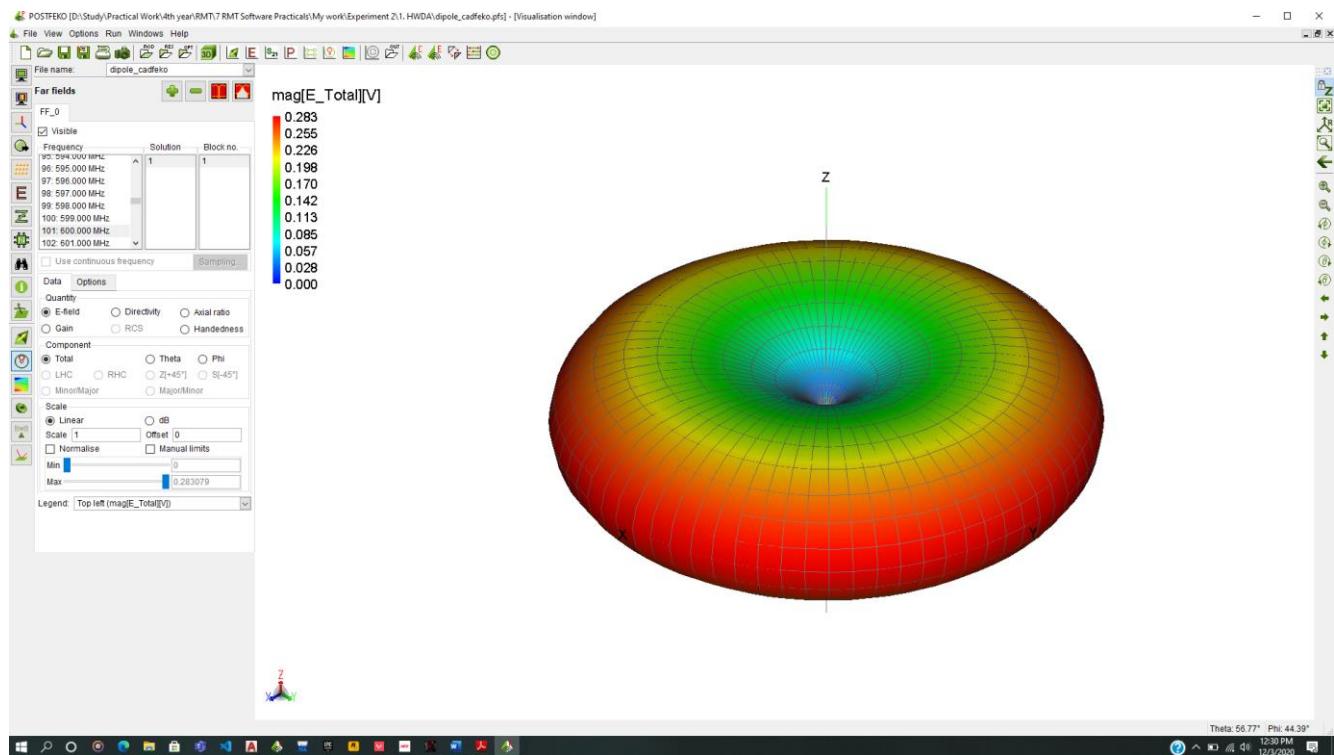
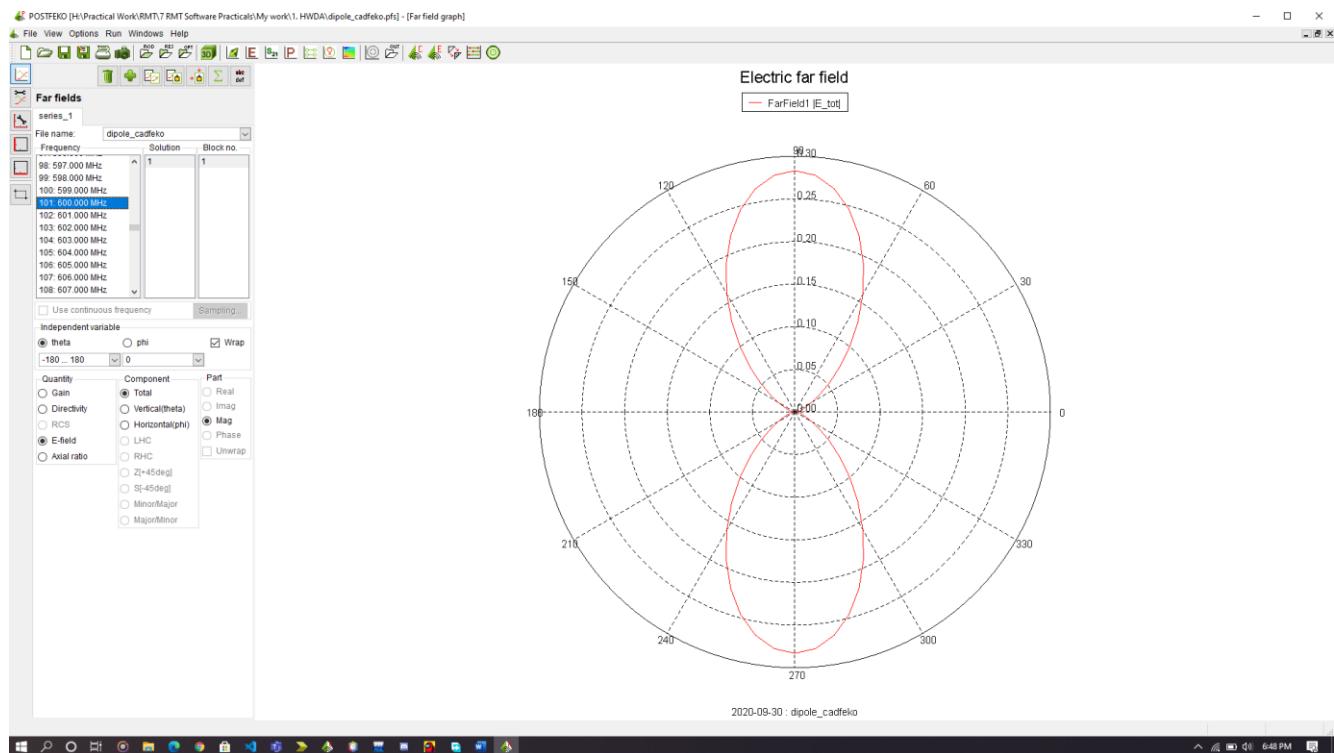


### Gain of Lambda antenna ( $\lambda$ )



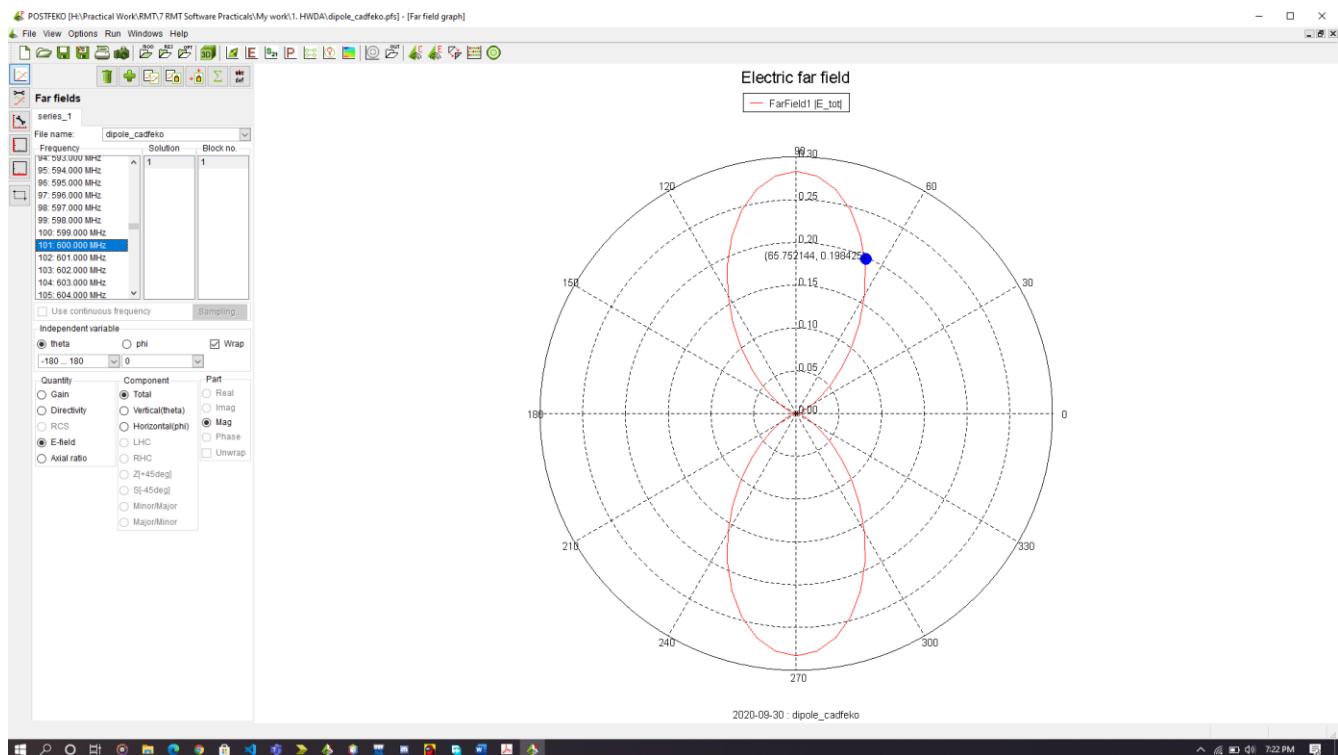


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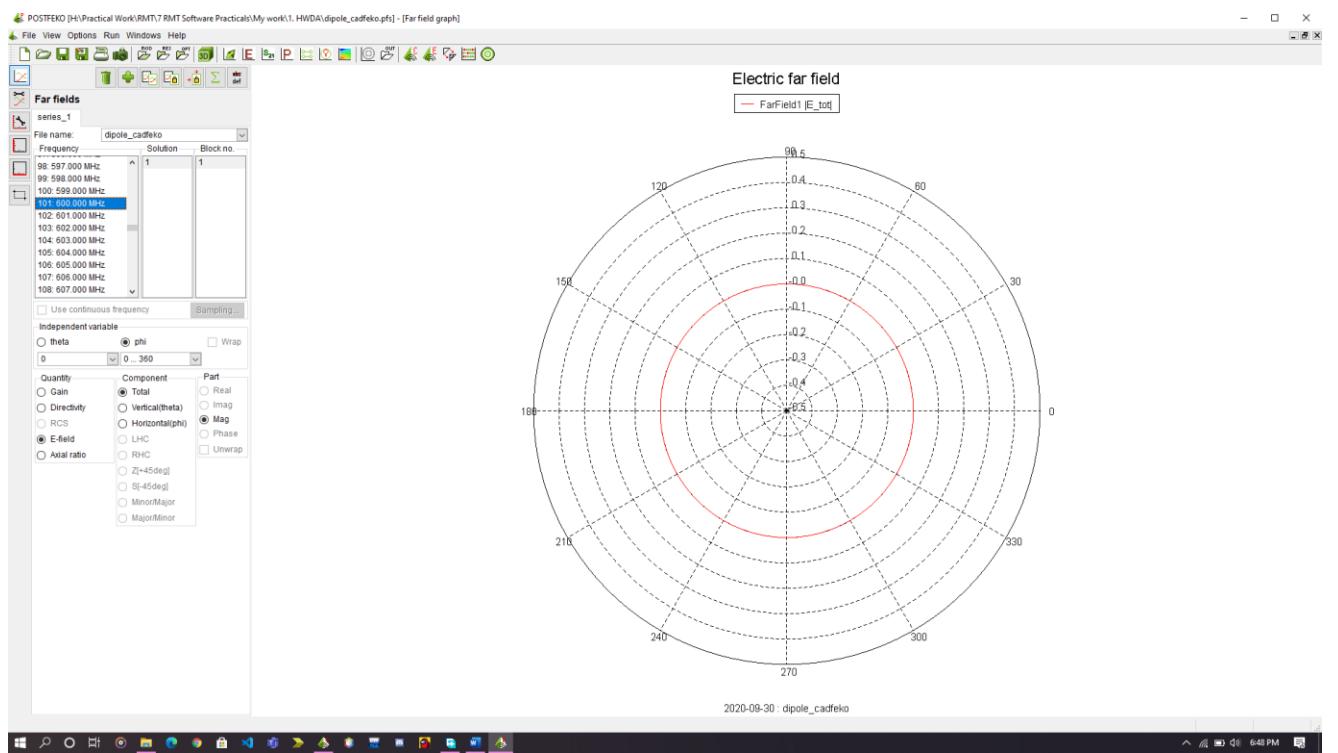
3-D Radiation Pattern of  $\lambda$  antenna2-D(E-Plane Radiation Pattern) of ( $\lambda$ )

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### Beamwidth (E-Plane Radiation Pattern) of ( $\lambda$ )

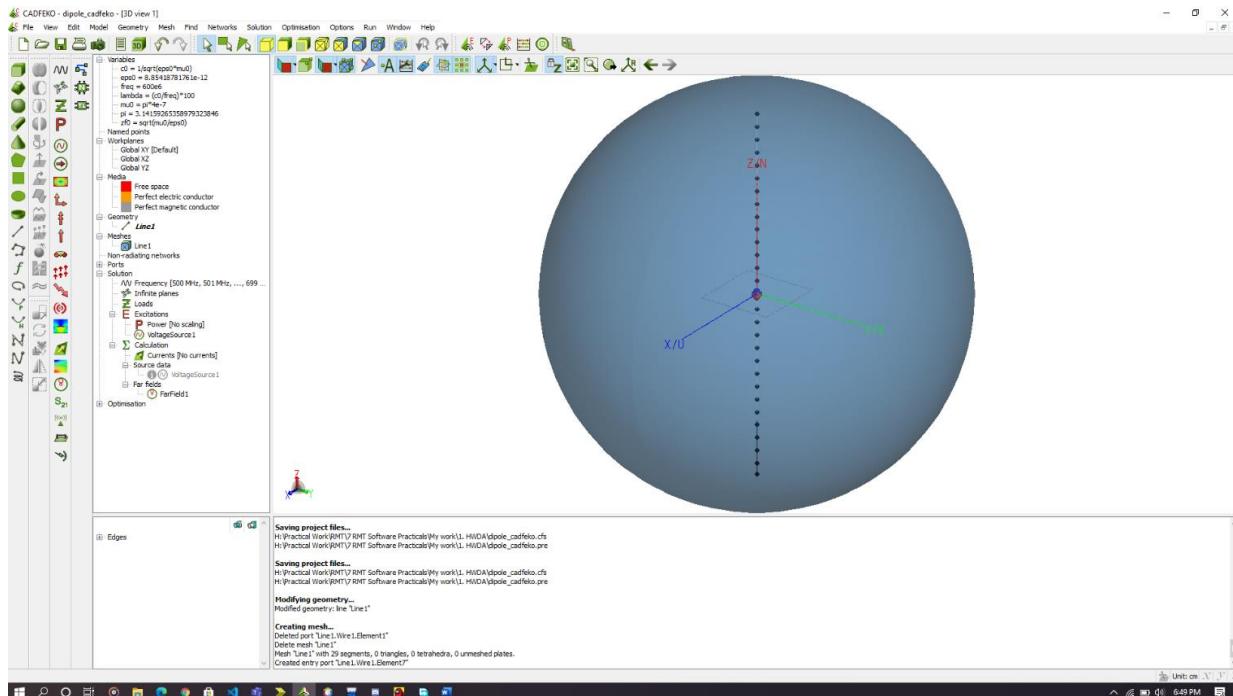


### 2-D(H-Plane Radiation Pattern) of ( $\lambda$ )

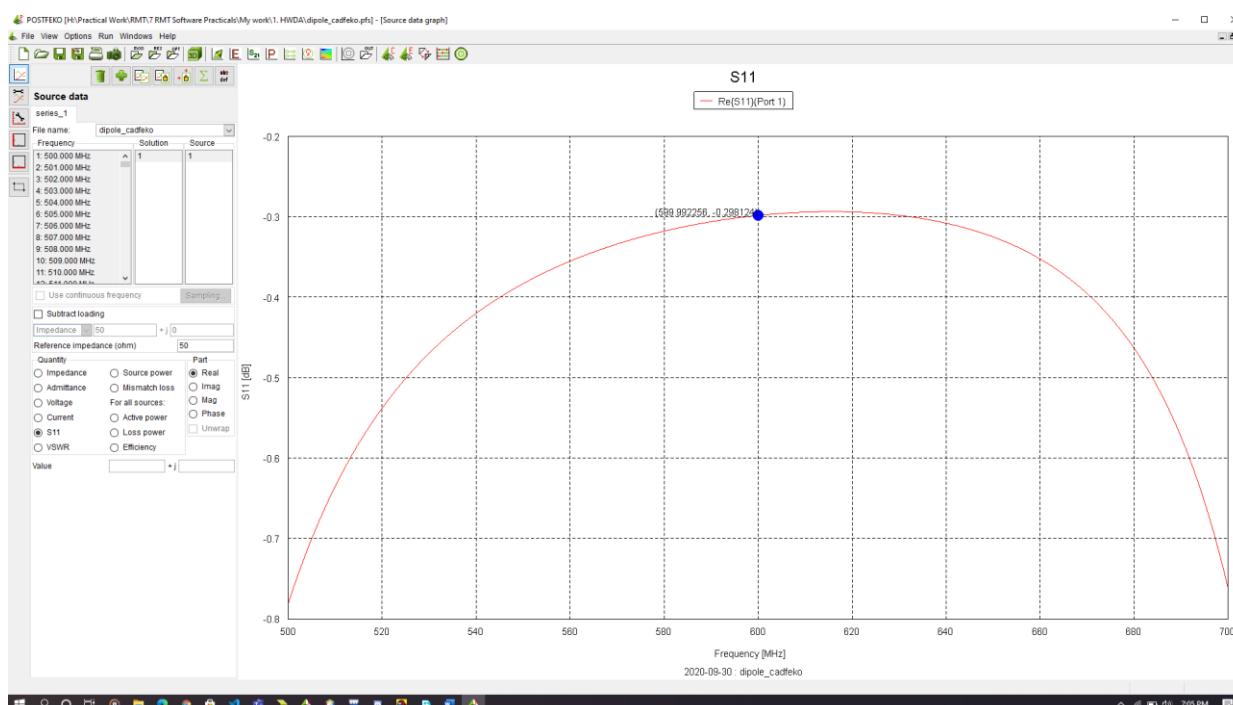




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2\* $\lambda$  antennaStructure of 2\*Lambda antenna (2\* $\lambda$ )Return Loss of 2\*Lambda antenna (2\* $\lambda$ )

At freq=600MHz,  $s_{11}=0.966212-j0.012583$

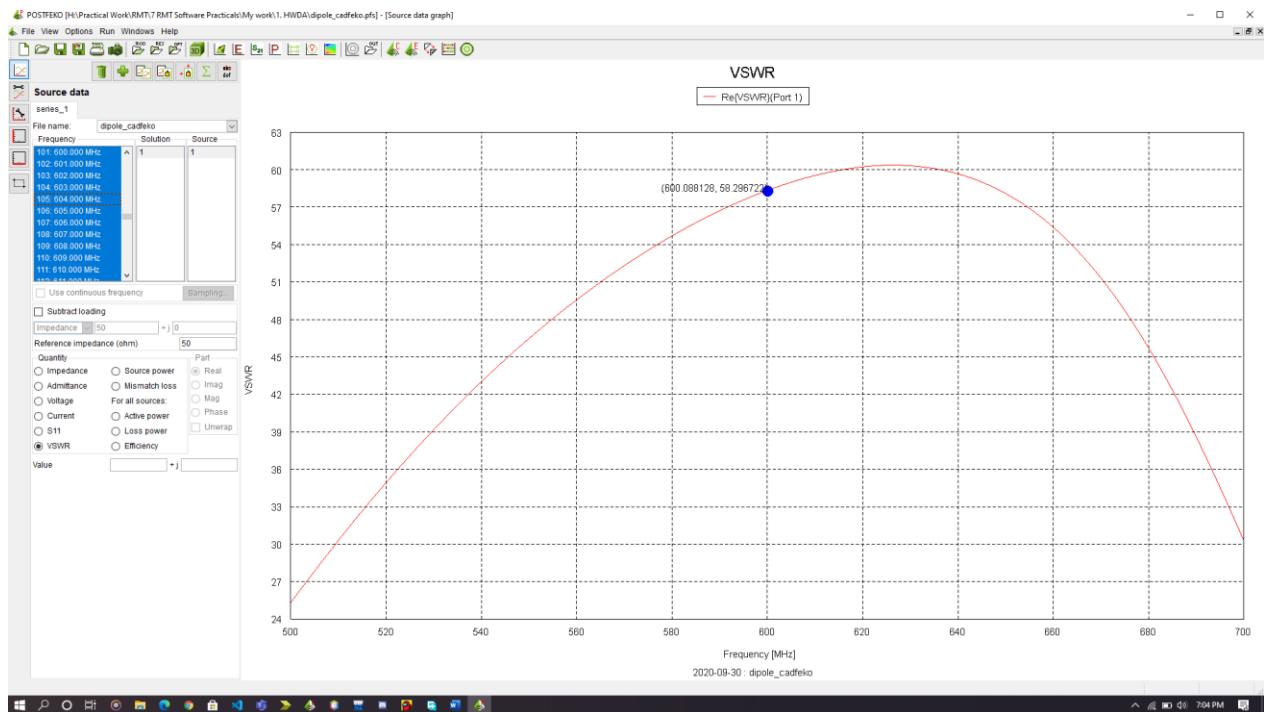




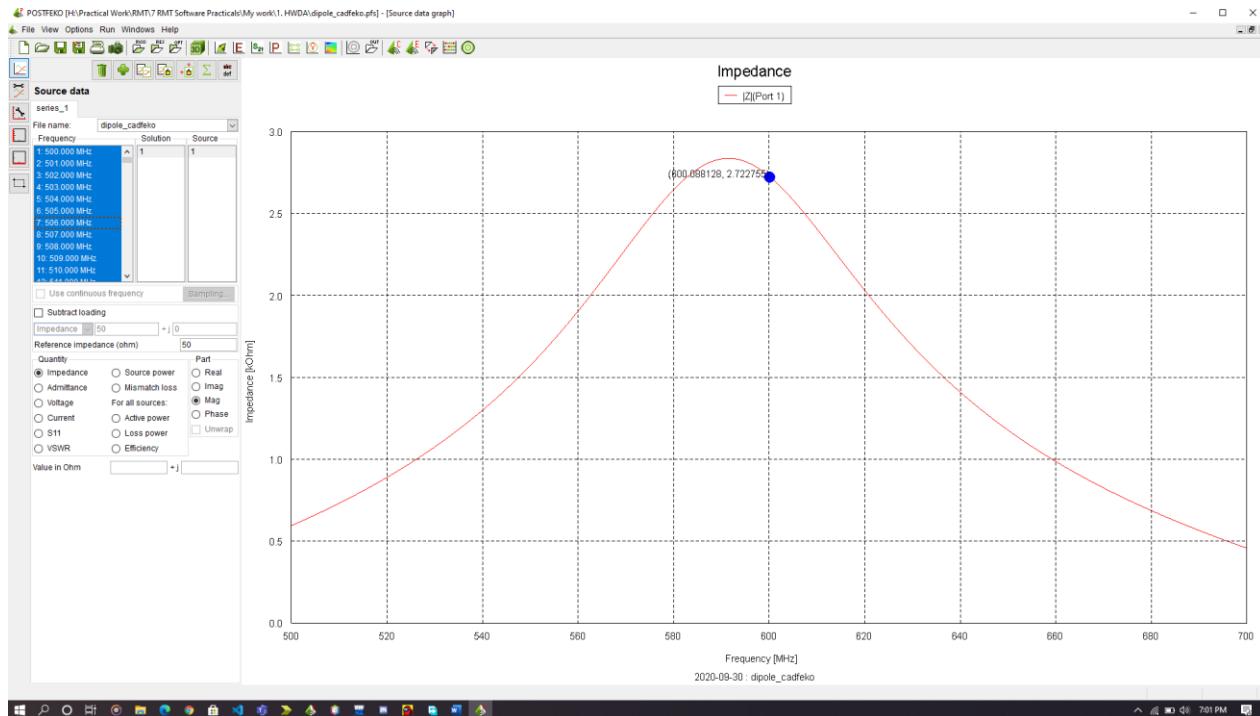
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VSWR of 2\*Lambda antenna ( $2^*\lambda$ )

At freq=600MHz, VSWR=58.3372

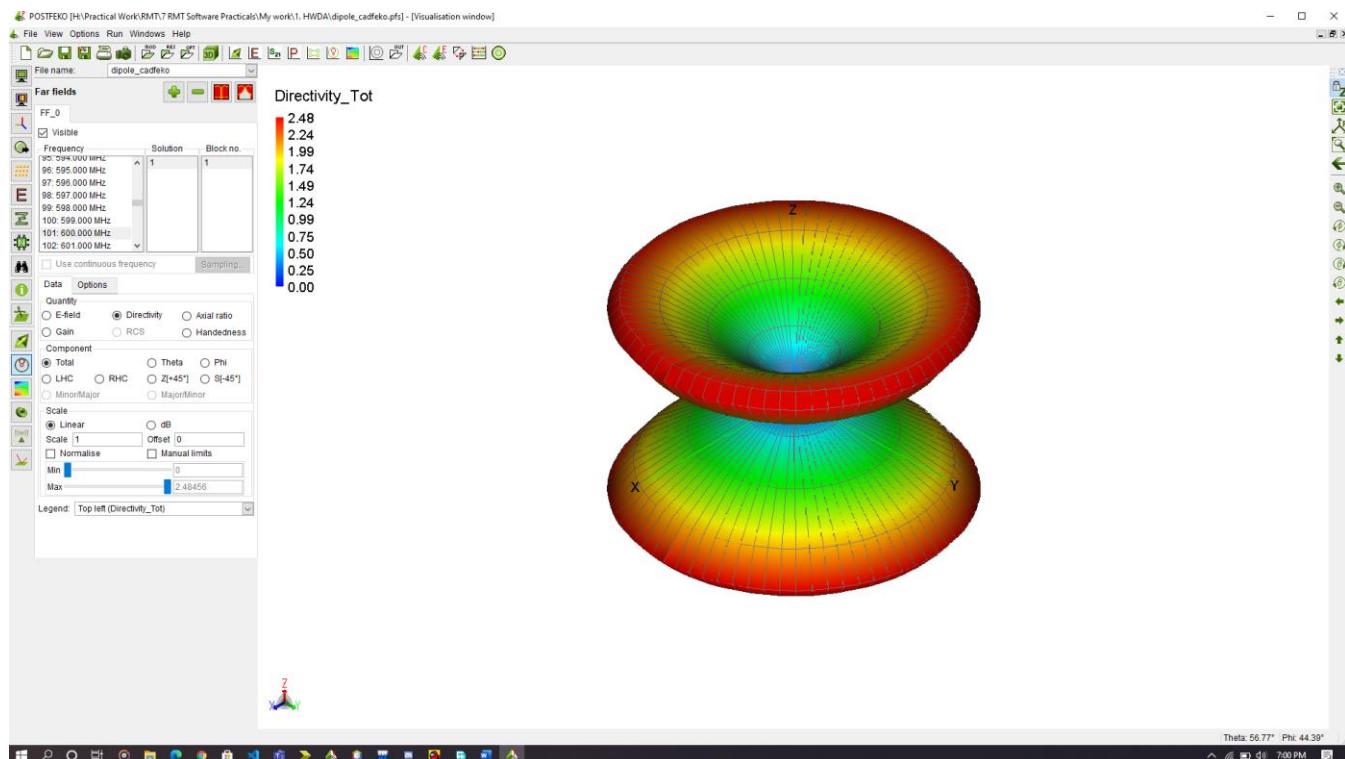
Impedance of 2\*Lambda antenna ( $2^*\lambda$ )

At freq=600MHz,  $Z = 2549.18 - j967.975 \text{ ohm}$

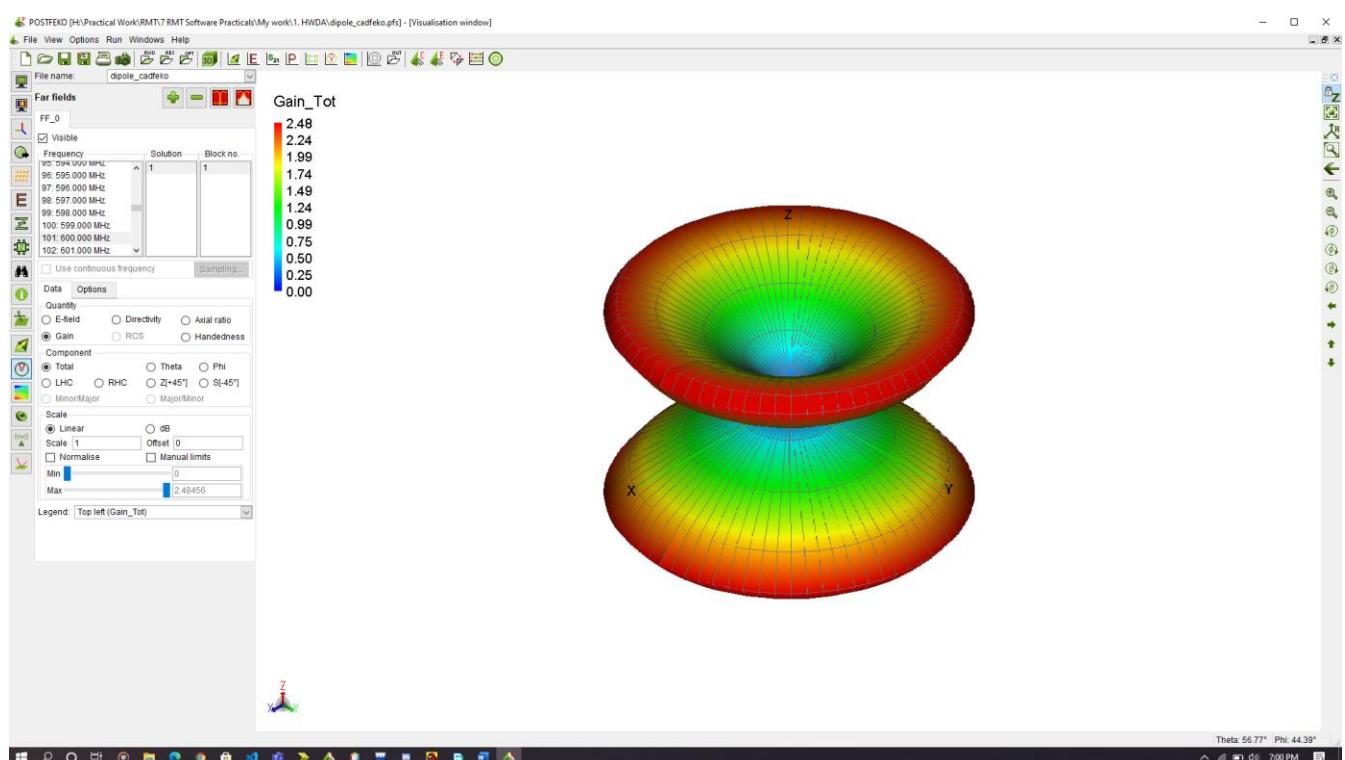


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### Directivity of 2\*Lambda antenna ( $2^* \lambda$ )

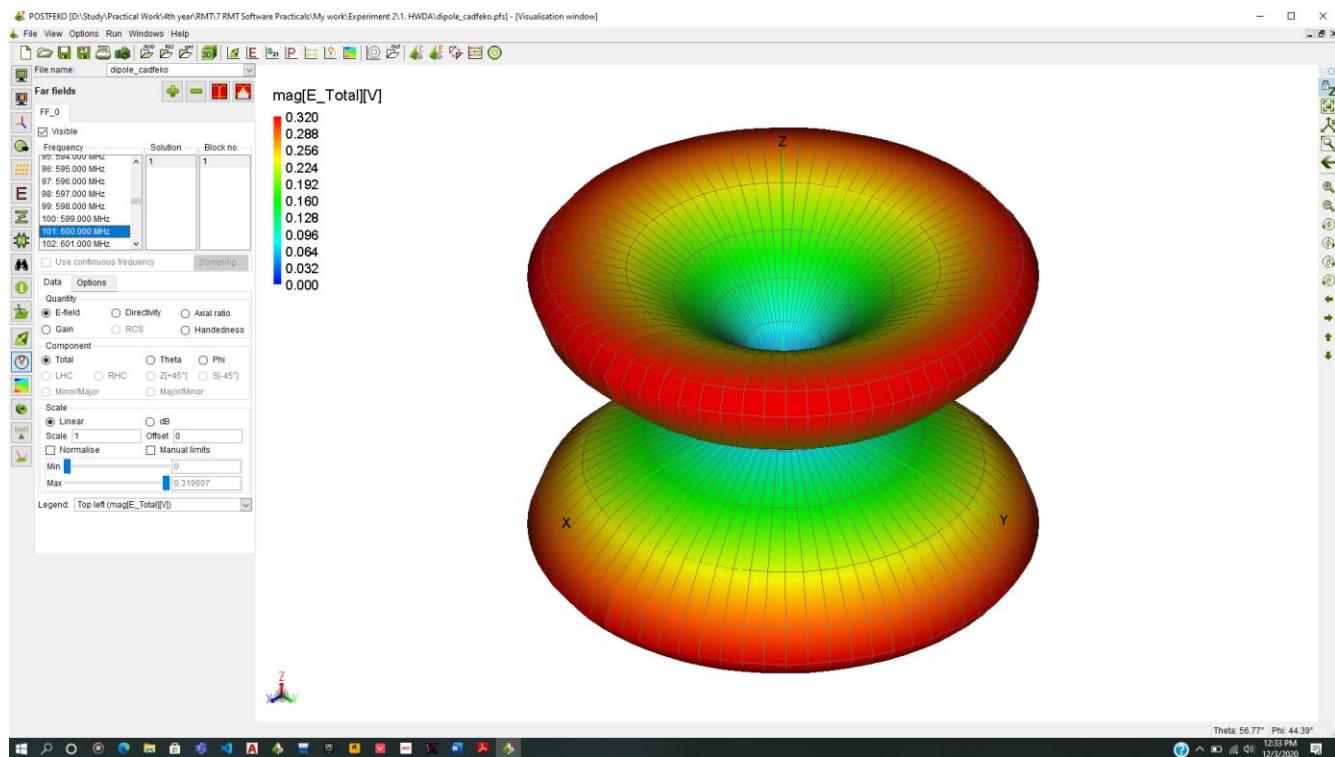
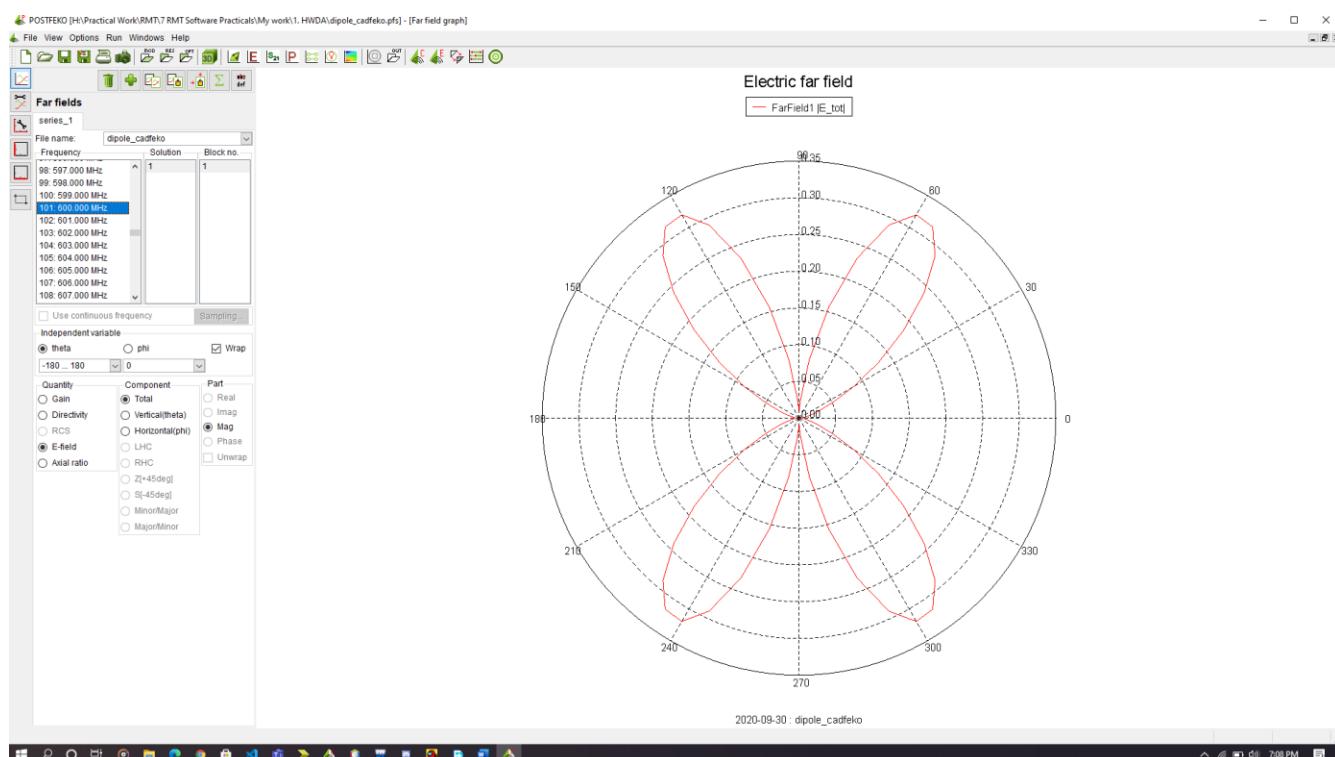


### Gain of 2\*Lambda antenna ( $2^* \lambda$ )



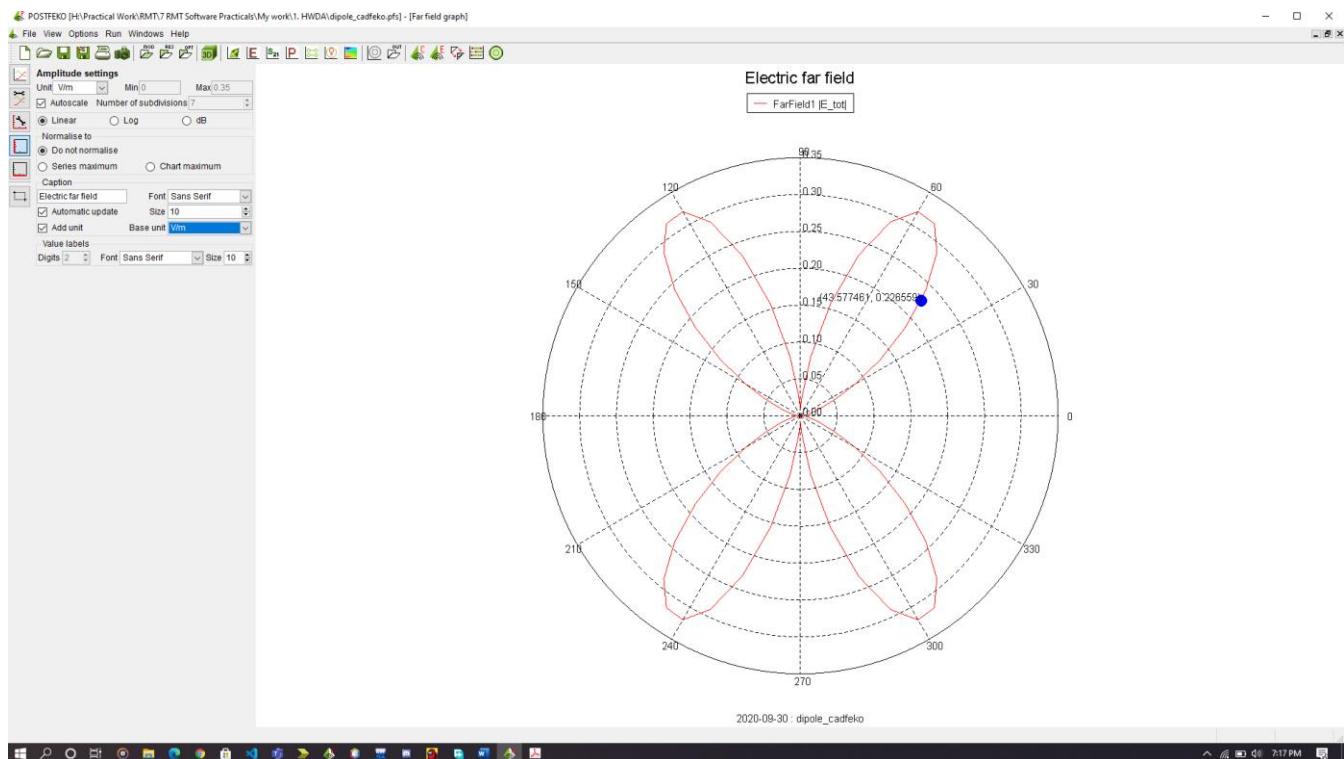
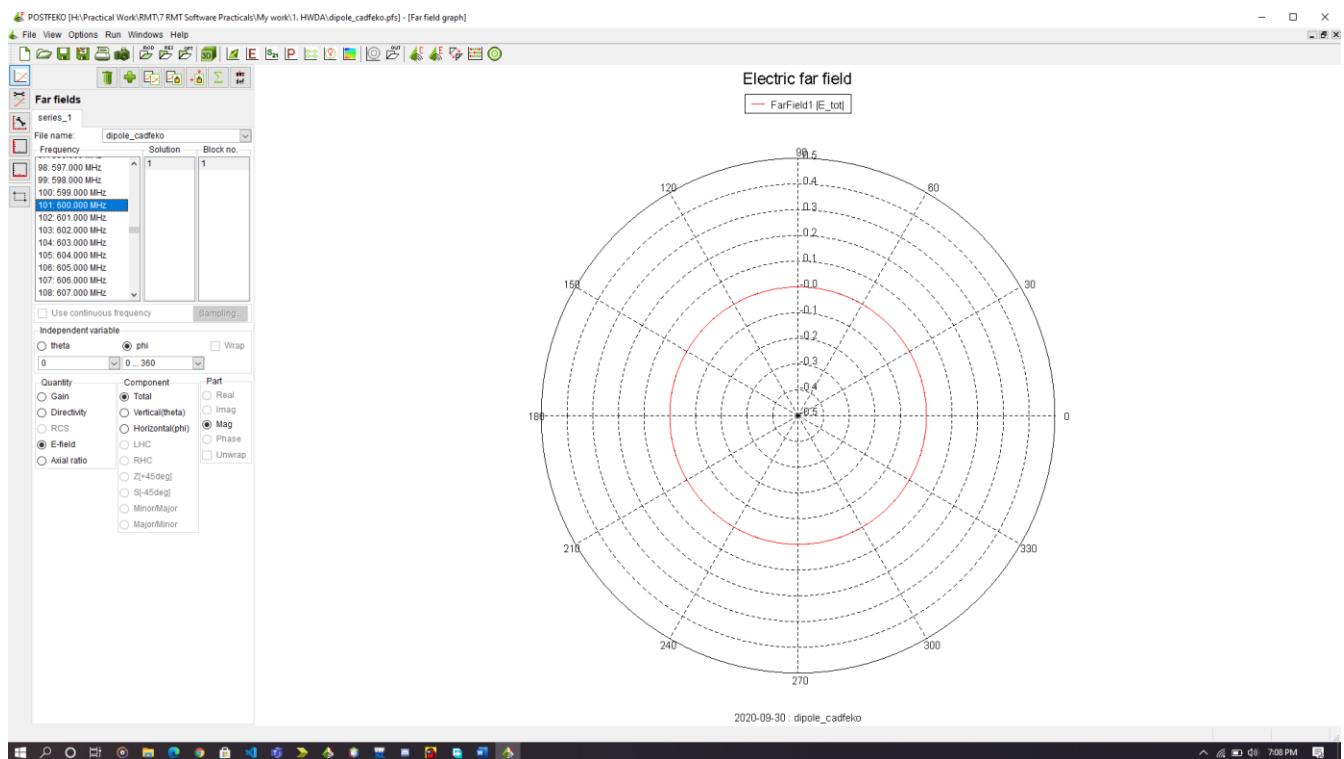


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3-D Radiation Pattern of  $2^* \lambda$  antenna2-D(E-Plane Radiation Pattern) of  $(2^* \lambda)$ 



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Beamwidth (E-Plane Radiation Pattern) of  $(2^* \lambda)$ 2-D(H-Plane Radiation Pattern) of  $(2^* \lambda)$ 



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### CONCLUSION:

1. Radiation pattern is like 8 shaped pattern i.e. with two lobes perpendicular to antenna axis in case of lengths  $\lambda/4$ ,  $\lambda/4$  and  $\lambda$ . Radiation pattern for length  $2*\lambda$  has 4 lobes.
2. Return loss should be as low as possible i.e. it should be as negative as possible in dB which we observe in case of length  $\lambda/2$  (-15.2798 dB).
3. VSWR is close to ideal (= 1) in case of length  $\lambda/2$  (= 1.41721) and has highest value in case of length  $\lambda/4$  (= 660.57). After length  $\lambda/2$ , lowest VSWR is in case of length  $2*\lambda$  (= 58.3372) and then length  $\lambda$  (= 73.4107).
4. Impedance is near to 73 ohms in case of length  $\lambda/2$ . It is large in case of length  $\lambda/4$  and is very large in case of lengths  $\lambda$  and  $2*\lambda$ .
5. Gain is lowest in case of length  $\lambda/4$  and is increasing as length increases. Highest in case of length  $2*\lambda$ .
6. Half Power Beam Width is highest in case length  $\lambda/4$  which makes it less directive and is highest in case of length  $2*\lambda$ .
7. All had the H-pattern of circle making the H-plane HPBW 360 degrees.

### REFERENCES:

1. Antenna Theory: Analysis and design, Constantine A. Balanis, 3<sup>rd</sup> Edition, John Wiley & Sons Ltd.
2. Principles of Antenna Theory, Kai Fong Lee, 1984, John Wiley and Sons Ltd. ISBN 0 471 90167 9.