

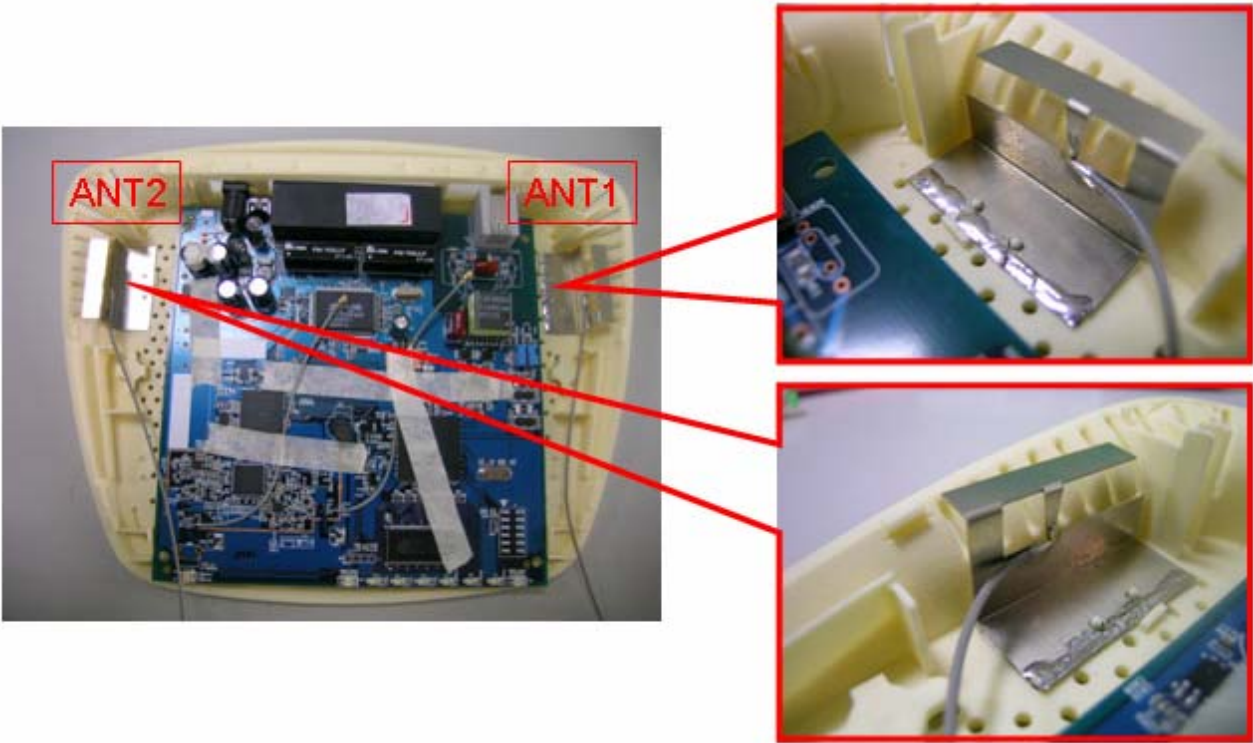
# Antenna Design For MIMO AP

V6.00

<b>Document Number</b>	<b>NP-7099</b>
<b>1<sup>st</sup> Released Date</b>	<b>10/29/07</b>
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<b>Review by</b>	<b>Romeo Chou</b>

<b>Rough description</b>	2 antennas for a MIMO AP. Isolation between antennas must be under minus 25dB.	
<b>Item</b>	<b>Initial Specification</b>	<b>Final Specification</b>
<b>Dimensions</b>	31*22*16t for antenna1&2	
<b>Impedance</b>	50Ω	
<b>Test environment</b>	None	
<b>Spectrum</b>	None	
<b>Freq. Range</b>	2.4~2.5GHz	
<b>Gain</b>	2dBi	
<b>VSWR</b>	None	
<b>Radiation</b>	PIFA	
<b>Polarization</b>	linear	
<b>HPBW / H</b>	None	
<b>HPBW / E</b>	None	
<b>Rad. efficiency</b>	None	
<b>Total efficiency</b>	None	
<b>Downtilt</b>	None	
<b>Connector type</b>	None	
<b>Cable type</b>	None	
<b>Isolation</b>	< -25dB	

1 Antenna Appearance



## 2 Electrical Test Charts

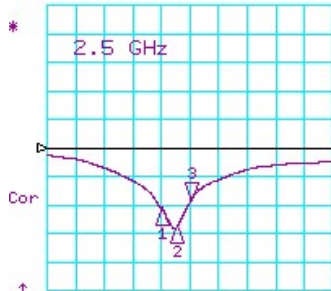
### 2.1 Return Loss

S11:2.4~2.5GHz (Ant1)

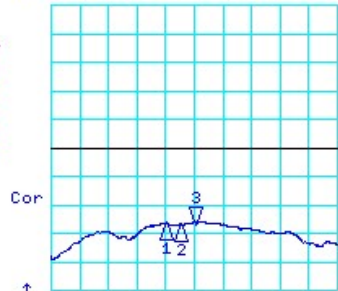
S22:2.4~2.5GHz (Ant2)

9 Nov 2007 08:09:39  
 CH1 LOG 10 dB/ REF 0 dB  
 S11 3:-18.634 dB 2 500.000 000 MHz

CH2 LOG 10 dB/ REF 0 dB  
 S21 3:-27.226 dB 2 500.000 000 MHz



CH1 Markers  
 1:-21.155 dB  
 2.40000 GHz  
 2:-27.848 dB  
 2.45000 GHz



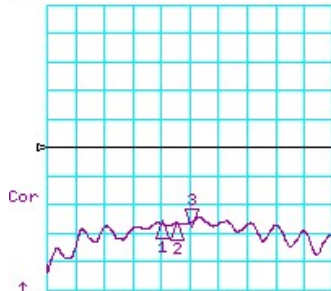
CH2 Markers  
 1:-26.613 dB  
 2.40000 GHz  
 2:-27.127 dB  
 2.45000 GHz

START 2000.000 MHz STOP 3000.000 MHz

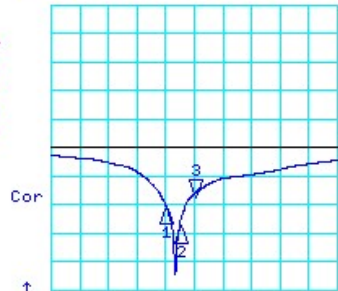
START 2000.000 MHz STOP 3000.000 MHz

CH3 LOG 10 dB/ REF 0 dB  
 S12 3:-27.569 dB 2 500.000 000 MHz

CH4 LOG 10 dB/ REF 0 dB  
 S22 3:-17.515 dB 2 500.000 000 MHz



CH3 Markers  
 1:-26.084 dB  
 2.40000 GHz  
 2:-26.793 dB  
 2.45000 GHz



CH4 Markers  
 1:-21.167 dB  
 2.40000 GHz  
 2:-27.627 dB  
 2.45000 GHz

START 2000.000 MHz STOP 3000.000 MHz

START 2000.000 MHz STOP 3000.000 MHz

## 2.2 Return Loss Table

## 2.4~2.5GHz(Return Loss)

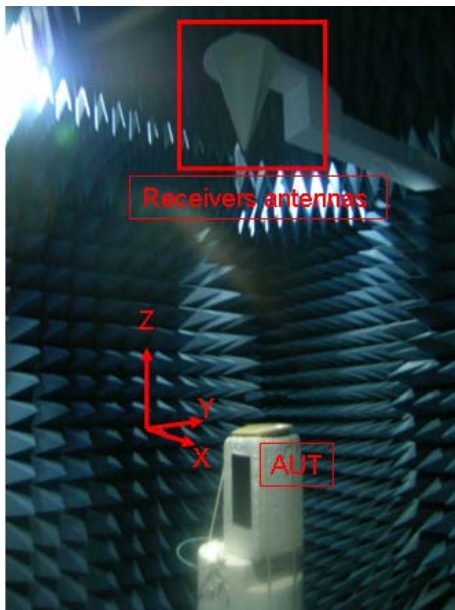
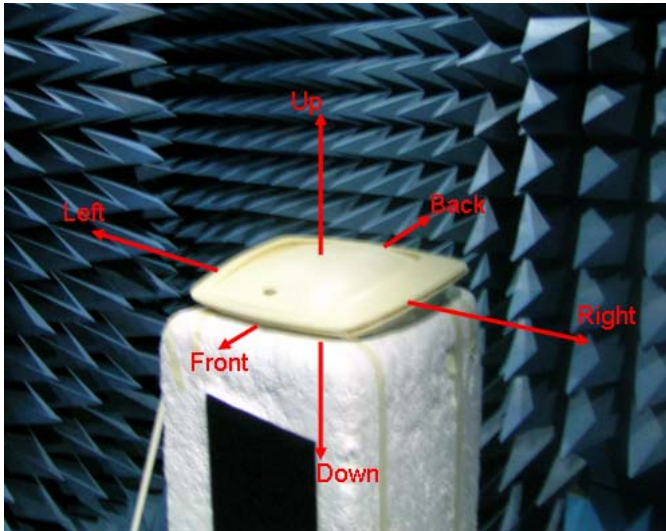
	S11(ANT1)	S22(ANT2)
2.4GHz	-21.16dB	-21.17dB
2.45GHz	-27.85dB	-27.63dB
2.5GHz	-18.63dB	-17.52dB

## 2.4~2.5GHz(Two Antenna Isolation)

	S12	S21
2.4GHz	-26.08dB	-26.61dB
2.45GHz	-26.79dB	-27.13dB
2.5GHz	-27.57dB	-27.23dB

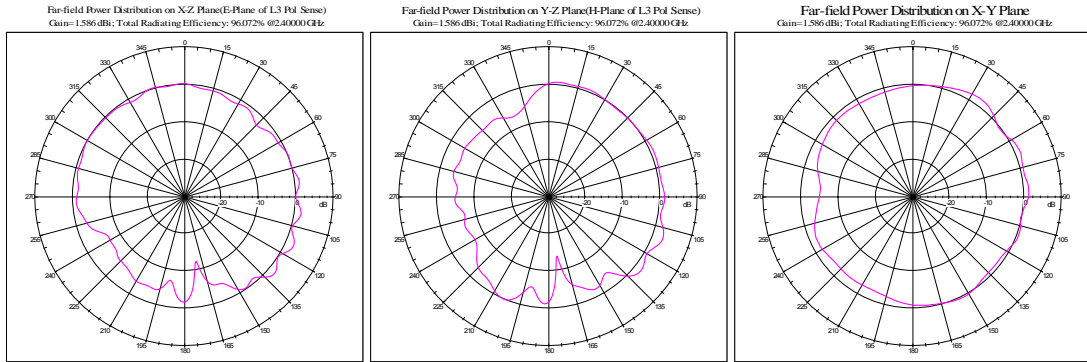
### 3 Pattern charts

#### 3.1 Measurement location of the antenna

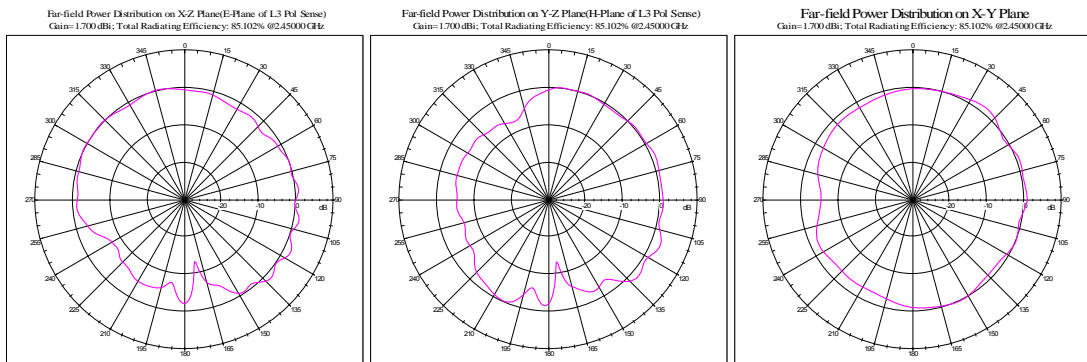


	XY	YZ	XZ
0°	Right	Up	Up
90°	Front	Back	Right
180°	Left	Down	Down
270°	Back	Front	Left

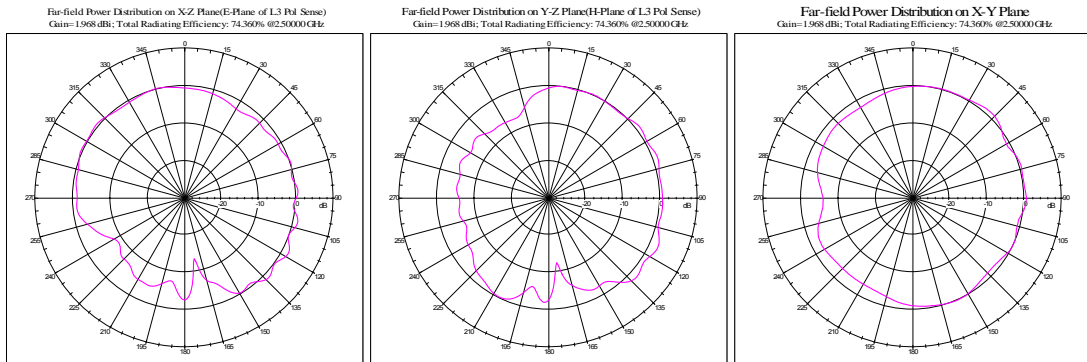
### 3.2 Ant1 Gain Table 2.4~2.5GHz



**2.4GHz      Gain=1.586dBi      Efficiency=96.072%**

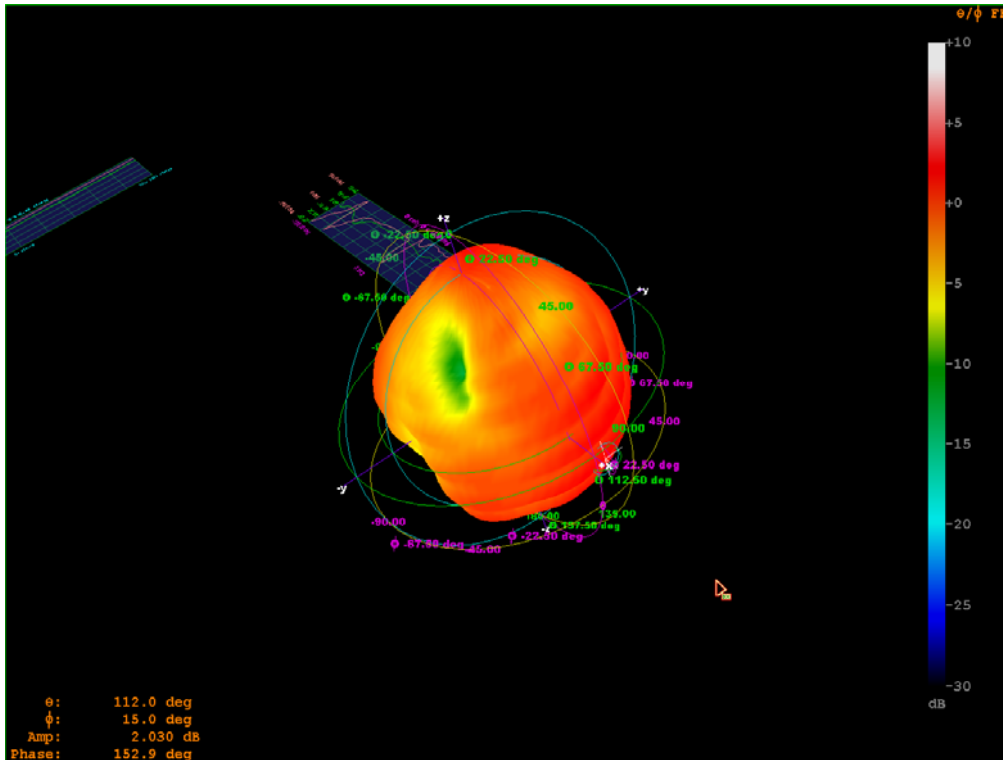


**2.45GHz      Gain=1.700dBi      Efficiency=85.102%**

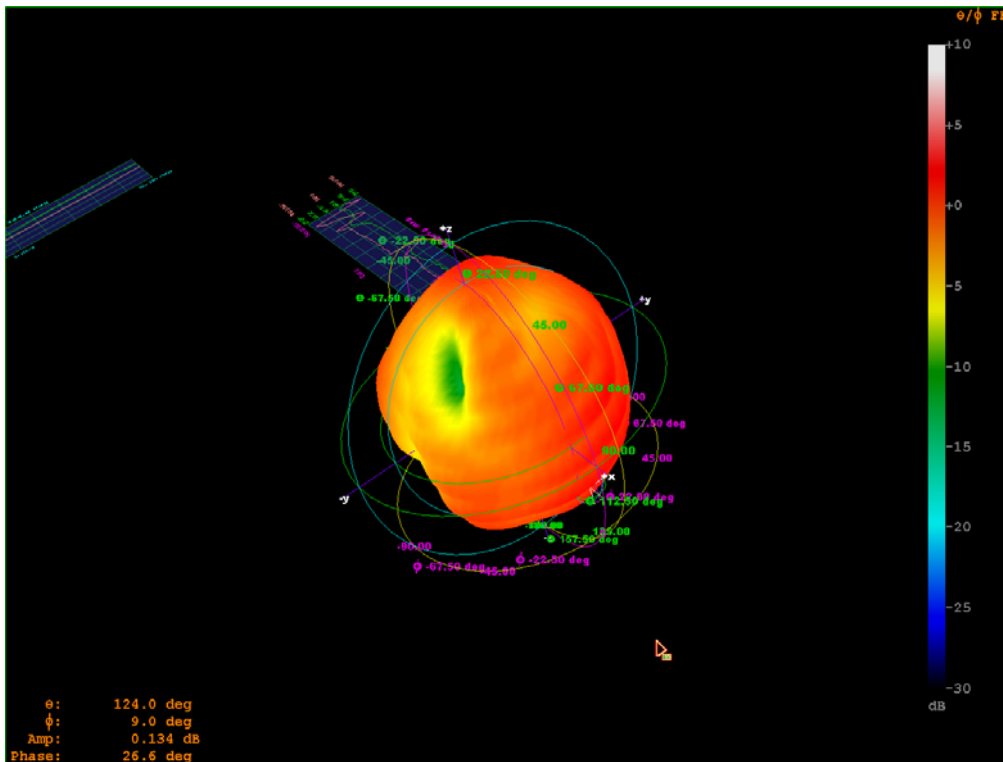


**2.5GHz      Gain=1.968dBi      Efficiency=74.360%**

3.3 3D Pattern  
2.4GHz

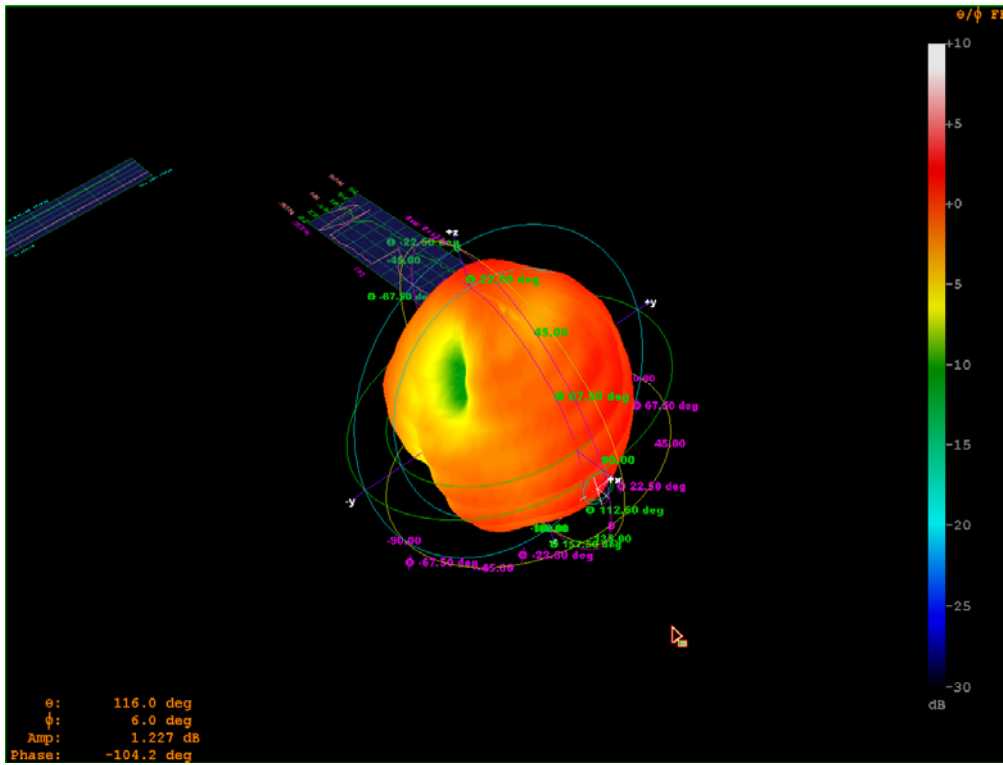


2.45GHz

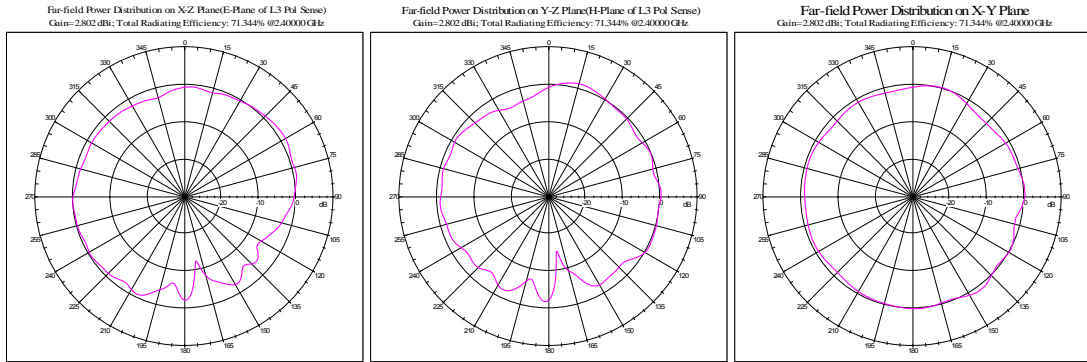




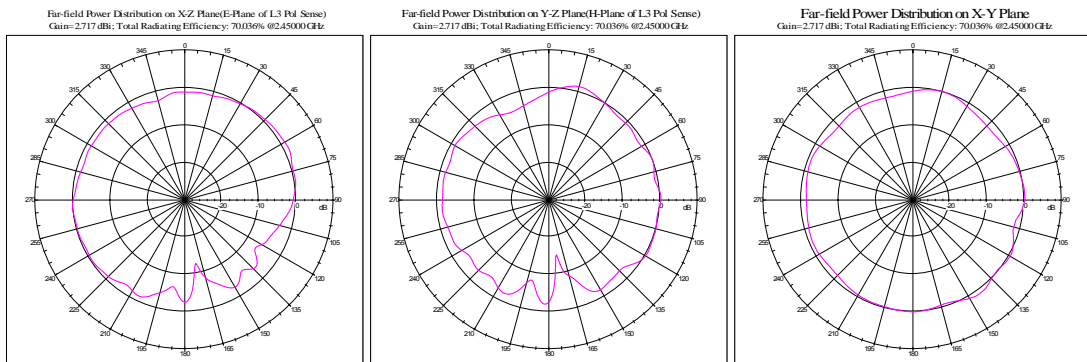
2.5GHz



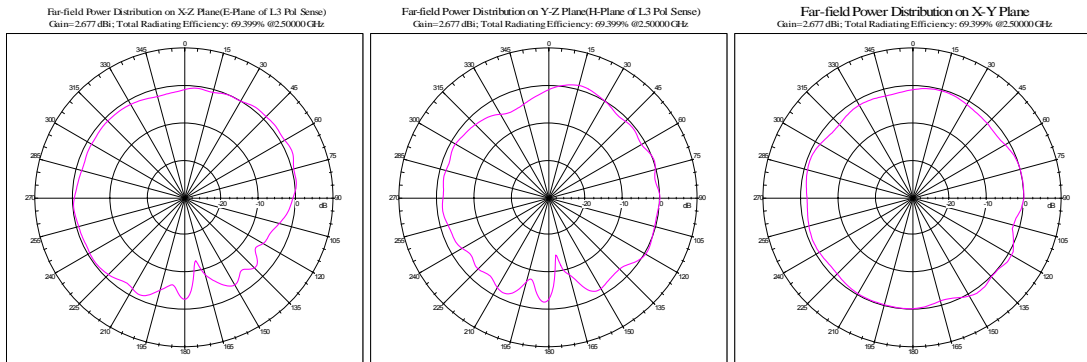
### 3.4 Ant2 Gain Table 2.4~2.5GHz



**2.4GHz      Gain=2.802dBi      Efficiency=71.344%**

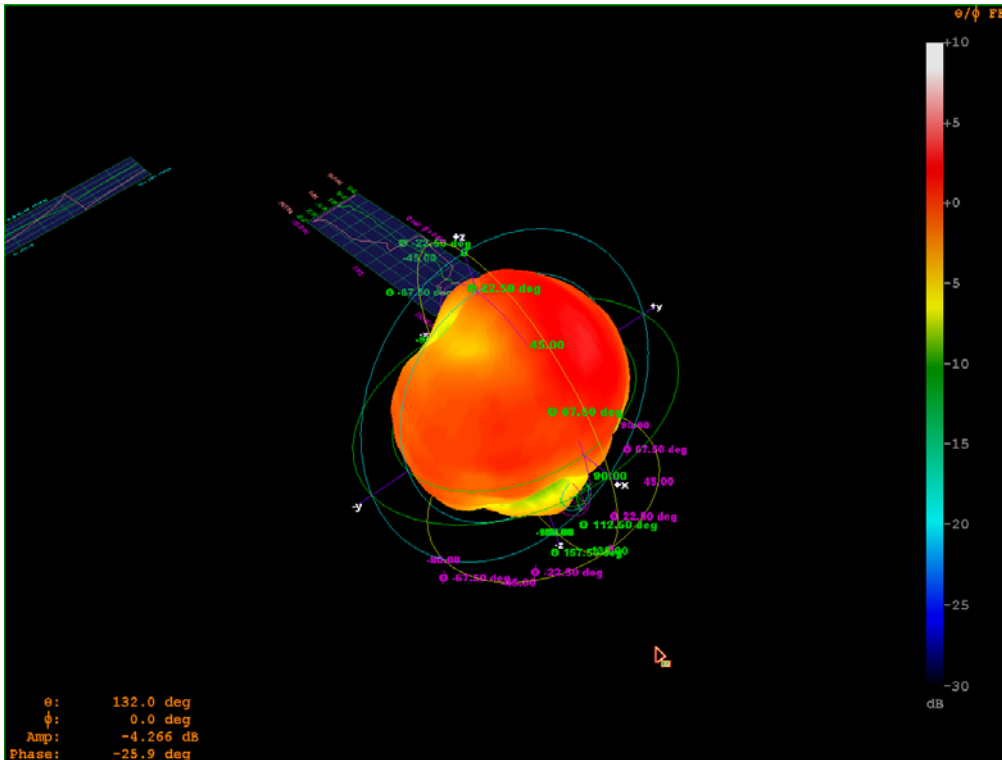


**2.45GHz      Gain=2.717dBi      Efficiency=70.036%**

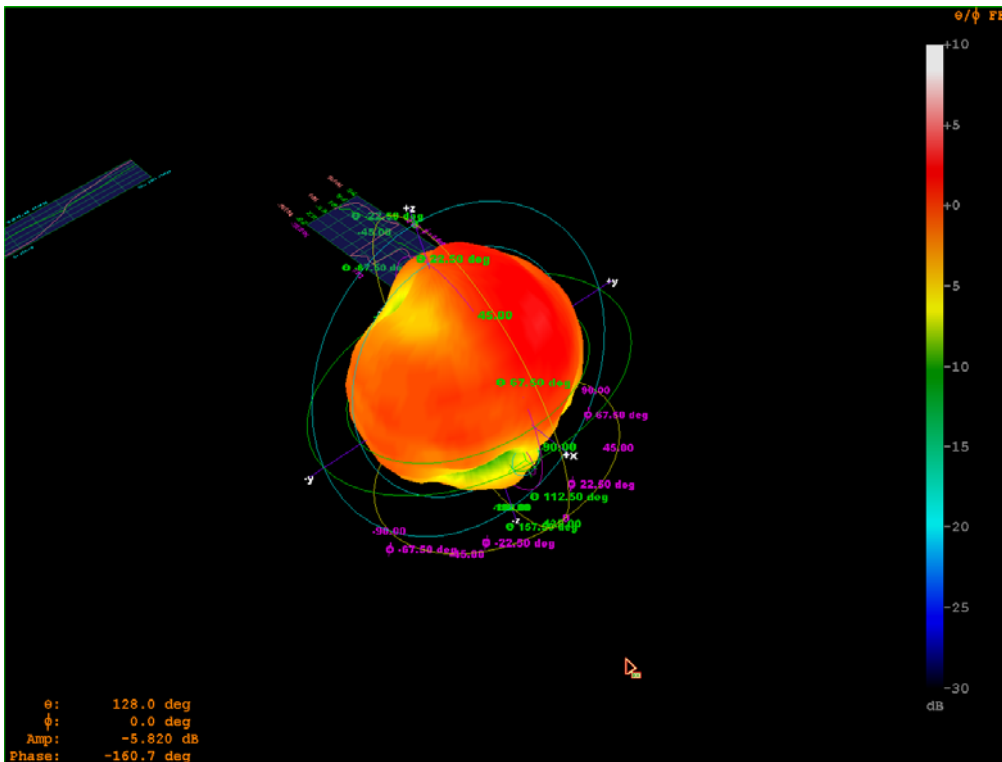


**2.5GHz      Gain=2.677dBi      Efficiency=69.399%**

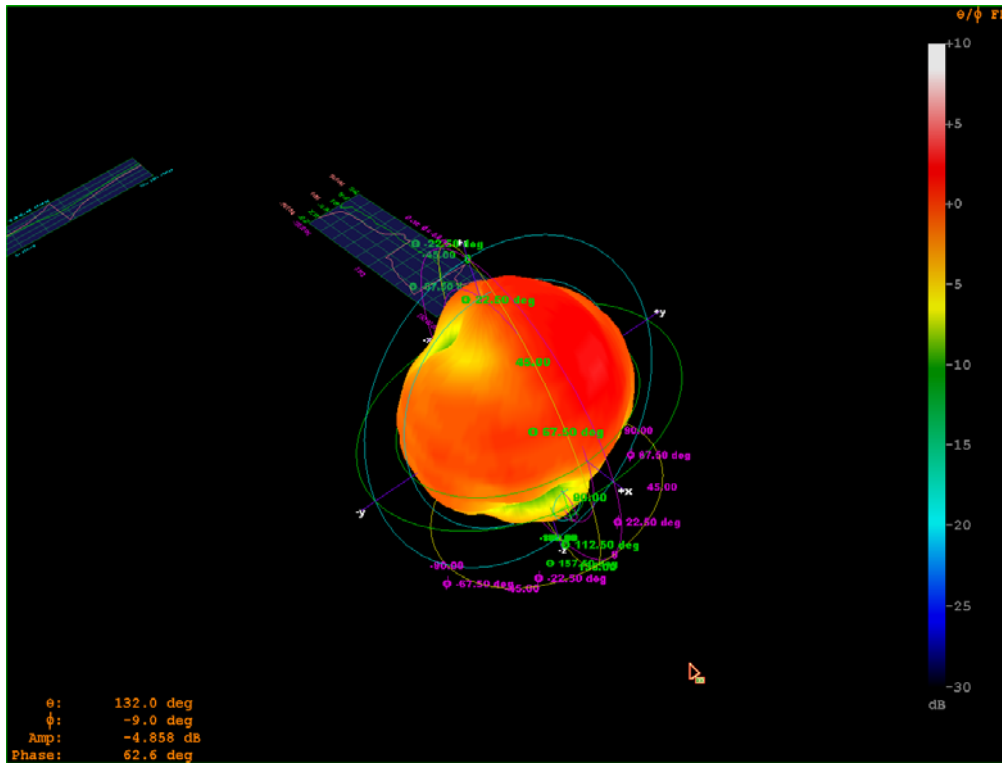
3.5 3D Pattern  
2.4GHz



2.45GHz



2.5GHz



### 3.6 Peak Gain & Efficiency & 3dB Beam Width

Gain Table 2.4~2.5GHz(Peak Gain)

	Ant 1		Ant 2	
	Peak Gain	Efficiency	Peak Gain	Efficiency
2.4GHz	1.586dBi	96.072%	2.802dBi	71.344%
2.45GHz	1.700dBi	85.102%	2.717dBi	70.036%
2.5GHz	1.968dBi	74.360%	2.677dBi	69.399%

Gain Table 2.4~2.5GHz(Average Gain)

	Ant 1			Ant 2		
	X-Y	Y-Z	X-Z	X-Y	Y-Z	X-Z
2.4GHz	-1.078dBi	-2.138dBi	-1.608dBi	-0.890dBi	-2.010dBi	-1.819dBi
2.45GHz	-1.371dBi	-2.247dBi	-1.803dBi	-1.009dBi	-2.133dBi	-1.877dBi
2.5GHz	-1.527dBi	-2.214dBi	-1.814dBi	-1.049dBi	-2.128dBi	-1.781dBi

Gain Table 2.4~2.5GHz(3dB Beam Width)

	Ant 1			Ant 2		
	X-Y	Y-Z	X-Z	X-Y	Y-Z	X-Z
2.4GHz	138.8deg	139.5deg	77.71deg	Omni	129.5deg	107.4deg
2.45GHz	171.5deg	139.8deg	94.67deg	Omni	129.5deg	108.0deg
2.5GHz	Omni	143.4deg	100.0deg	Omni	132.1deg	102.3deg

## 4 Summary

- 4.1 Band Width: 2.4 ~ 2.5 GHz band of the S11 are lower than -10dB.
- 4.2 Isolation: 2.4 ~ 2.5 GHz band of the S12 are lower than -20dB.
- 4.3 Gain: ANT1's Peak Gain on average to 1.8dBi, Average Efficiency is 85.2%; ANT2's Peak Gain on average to 2.7dBi, Average Efficiency is 70.3%.
- 4.4 Average Gain: In the X-Y plane. ANT1's Average Gain is average of -1.325dBi; ANT2's Average Gain is average of -0.983dBi.