

An aerial view of a city at sunset, with a network of white lines and dots overlaid on the scene. The sun is low on the horizon, casting a warm glow over the buildings. A large blue semi-transparent banner is positioned across the middle of the image, containing the Airgain logo.

Airgain®))

Customer Name & Project: WX5610-B0

Prepared By: Terry Tao

Date: 23 March 2023

Airgain Project Code:

Test address:

24/F, Building B, Junma Land Plaza, Zhangjiagang City, Jiangsu Province

- This presentation summarizes the antennas system that Airgain plans to develop for WX5610-B0 project
- The antenna solution is updated based upon the actual devices provided by July 11, 2022

- 2 pcs 2G band (2.4~2.49GHz)
- 2 pcs 5GHz Single-band (5.15~5.85GHz)
- 4 pcs 6GHz Single-band (5.925~7.125GHz)

- Return loss < -10dB
- Isolation < -20dB
- Efficiency > 70%
- 5GHz & 6GHz <4.5 dBi, and 2.4GHz < 3.5 dBi

Airgain Antenna System Proposal

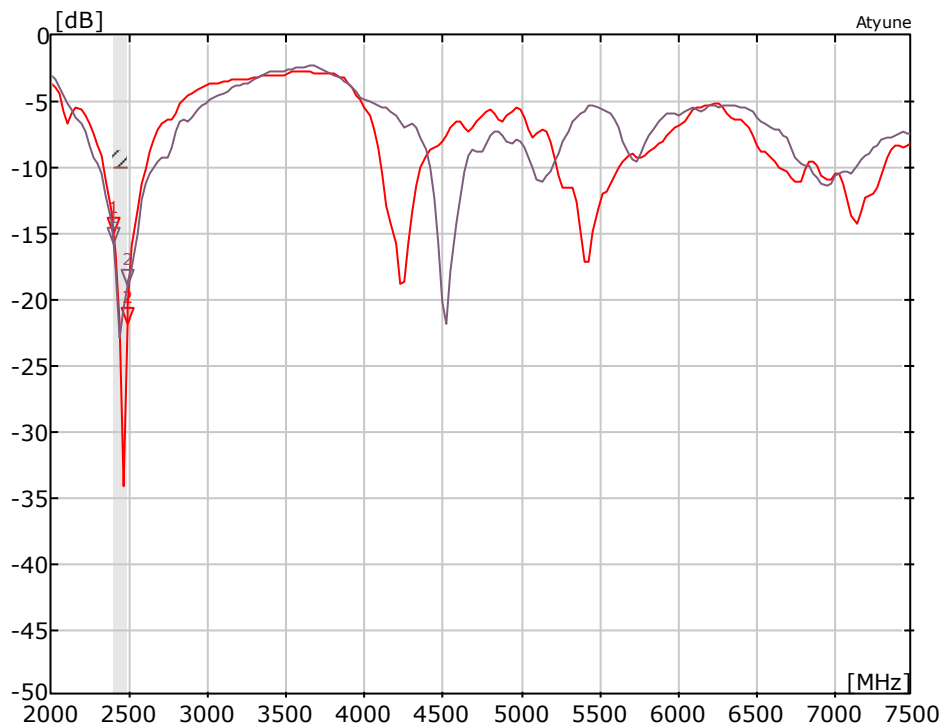
Antenna System Proposal



Antenna #	Part Number
Ant1_2G band	N01MSAMA-PK1-G85U
Ant3_2G band	N01MSAMB-PK1-B100U
Ant2_5GHz	N02MSAMC-PK1-W125U
Ant5_5GHz	N02MSAMD-PK1-A135U
Ant6_6GHz	N06MSAME-PK1-E165U
Ant7_6GHz	N06MSAMF-PK1-R175U
Ant8_6GHz	N06MSAMG-PK1-Y190U
Ant9_6GHz	N06MSAMH-PK1-P185U

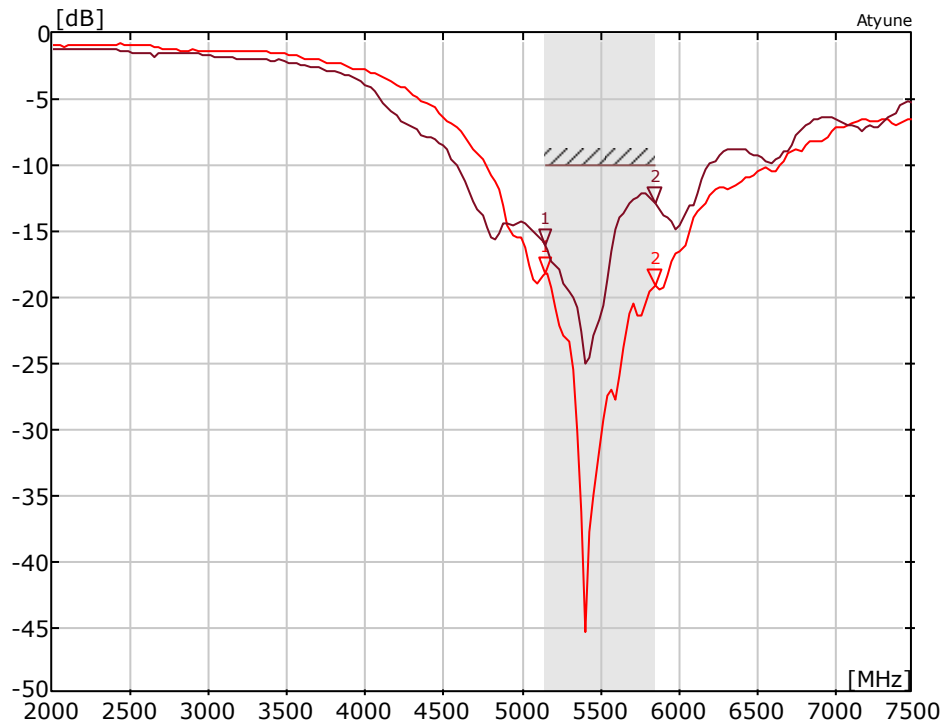
S-Parameters

S-Parameter – Return Loss for 2G band Wi-Fi Antennas



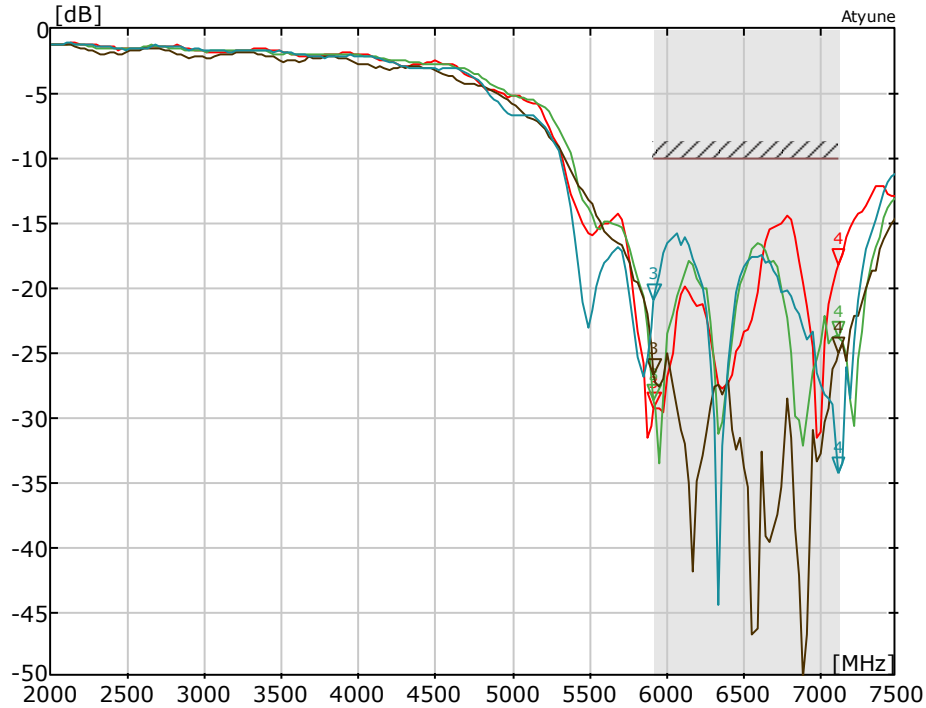
MARKERS:	MHz	dB
Ant1		
—	1: 2400	-14.86
—	2: 2490	-21.76
Ant3		
—	1: 2400	-15.69
—	2: 2490	-18.82

S-Parameter – Return Loss for 5GHz Wi-Fi Antennas



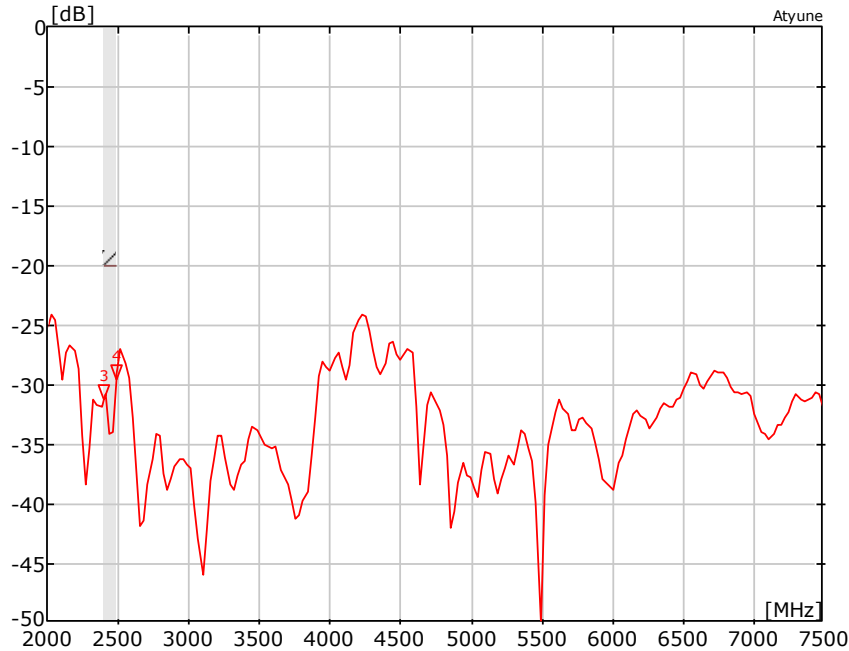
MARKERS:	MHz	dB
Ant2		
—	1: 5150	-18.04
—	2: 5850	-18.99
Ant5		
—	1: 5150	-16.02
—	2: 5850	-12.82

S-Parameter – Return Loss for 6GHz Wi-Fi Antennas



MARKERS:	MHz	dB
Ant6		
—	1: 5925	-29.22
—	2: 7125	-18.15
Ant7		
—	1: 5925	-28.52
—	2: 7125	-23.72
Ant8		
—	1: 5925	-26.55
—	2: 7125	-24.96
Ant9		
—	1: 5925	-20.76
—	2: 7125	-34.22

S-Parameter – Isolation Between All 2G band Antennas

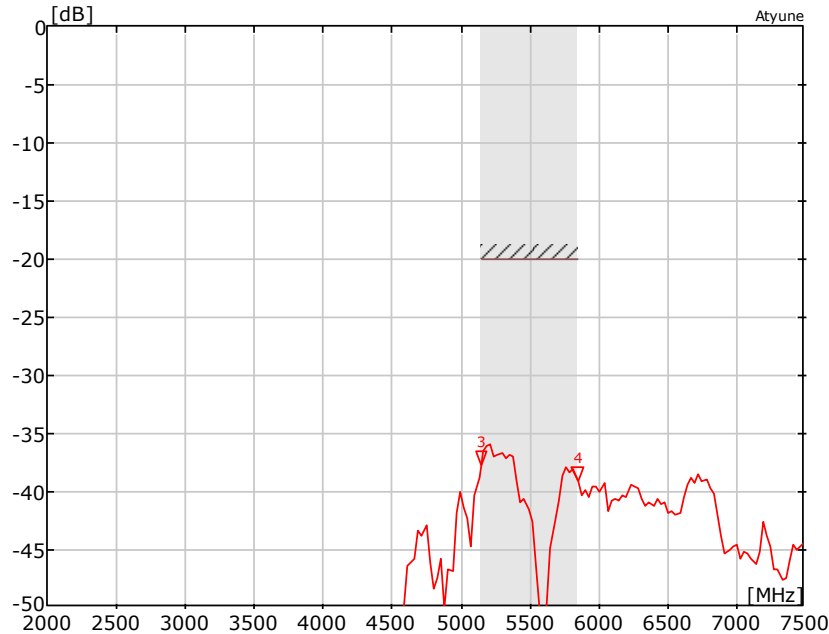


KEY OBSERVATIONS

Antenna	Minimum Isolation (dB) Max value between the frequency band
2.4G-2.49G	-29.3

Plot + table with values at the band edges

S-Parameter – Isolation Between All 5G band Antennas

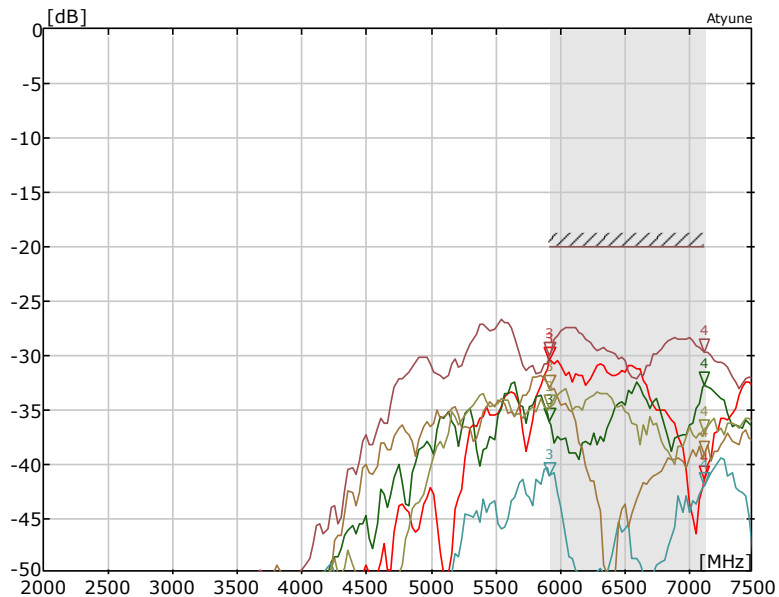


KEY OBSERVATIONS

Antenna	Minimum Isolation (dB) Max value between the frequency band
5.15G-5.85G	-36.0

Plot + table with values at the band edges

S-Parameter – Isolation Between All 6G band Antennas

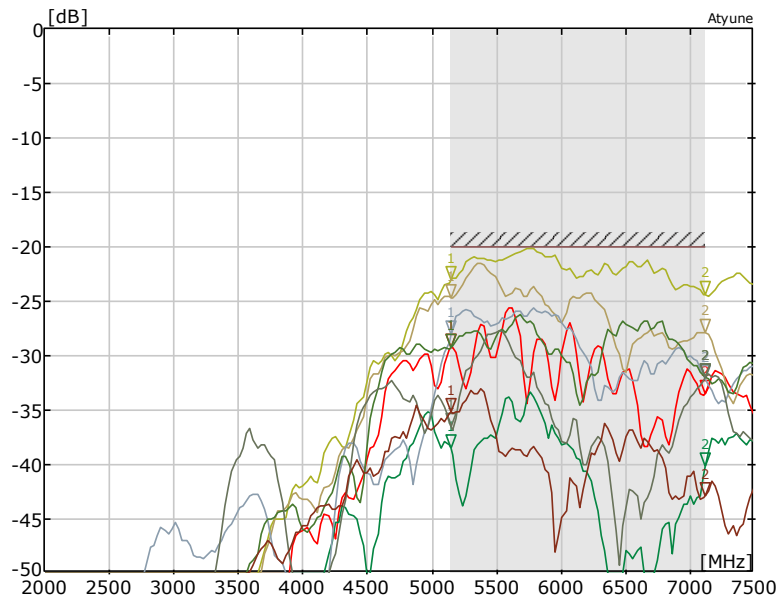


KEY OBSERVATIONS

Antenna	Minimum Isolation (dB) Max value between the frequency band
5.925G-7.125G	-27.5

Plot + table with values at the band edges

S-Parameter – Isolation Between All 5G&6G band Antennas



KEY OBSERVATIONS

Antenna	Minimum Isolation (dB) Max value between the frequency band
5.15G-7.125G	-20.1

Plot + table with values at the band edges

Radiated Measurements

Antenna Realized Efficiency & Peak Gain– 2.4 GHz Wi-Fi Antennas



Frequency (MHz)	Ant1_2G4 (%)	Ant3_2G4 (%)
2400	67.1	73.0
2412	68.7	73.0
2420	68.8	73.2
2430	68.5	72.4
2440	69.7	72.5
2450	70.1	72.1
2462	71.5	72.4
2470	72.2	72.7
2480	72.9	72.8
2490	73.3	72.4
Average	70.3	72.7

Frequency (MHz)	Ant1_2G4 (dBi)	Ant3_2G4 (dBi)
2400	3.2	4.5
2412	3.4	4.6
2420	3.4	4.7
2430	3.4	4.8
2440	3.6	4.8
2450	3.7	4.6
2462	3.9	4.6
2470	3.9	4.8
2480	3.9	5.0
2490	3.7	5.0

Antenna Realized Efficiency (%) – 5 GHz Wi-Fi Antennas



Frequency (MHz)	Ant2_5G (%)	Ant5_5G (%)
5150	69.8	68.3
5180	70.5	68.0
5200	71.7	68.9
5300	69.8	69.1
5400	67.2	67.2
5500	71.1	68.9
5600	71.6	66.8
5700	70.4	63.8
5785	70.7	63.7
5800	70.2	63.1
5850	69.1	62.5
Average	70.2	66.4

Frequency (MHz)	Ant2_5G (%)	Ant5_5G (%)
5925	70.6	62.7
6000	69.2	62.1
6100	67.8	61.8
6195	63.2	56.3
6300	61.7	54.8
6400	57.8	50.5
6500	58.8	52.4
6600	56.9	51.0
6700	56.1	45.7
Average	62.5	55.3

Antenna Peak Realized Gain – 5 GHz Wi-Fi Antennas



Frequency (MHz)	Ant2_5G (dBi)	Ant5_5G (dBi)
5150	5.3	4.9
5180	5.4	4.7
5200	5.5	4.6
5300	5.0	3.5
5400	4.1	3.8
5500	5.1	4.4
5600	5.0	4.1
5700	5.1	3.6
5785	5.0	3.6
5800	4.9	3.5
5850	4.9	3.3

Frequency (MHz)	Ant2_5G (dBi)	Ant5_5G (dBi)
5925	5.5	4.4
6000	5.6	4.9
6100	5.0	4.8
6195	4.1	4.6
6300	3.3	4.5
6400	3.4	3.9
6500	4.0	4.5
6600	3.8	4.9
6700	4.0	4.4

Antenna Realized Efficiency (%) – 6 GHz Wi-Fi Antennas



Frequency (MHz)	Ant6_6G (%)	Ant7_6G (%)	Ant8_6G (%)	Ant9_6G (%)
5500	63.0	55.6	59.0	61.1
5600	64.1	56.9	60.4	61.5
5700	65.4	58.6	62.6	62.1
5785	65.8	60.0	64.5	63.9
5800	66.8	60.0	65.2	64.3
5850	66.9	60.9	65.6	64.1
5925	68.4	64.0	67.7	64.5
6000	67.0	63.4	67.2	63.7
6100	67.6	63.7	67.0	62.9
6195	66.8	63.4	65.8	62.6
6300	65.8	64.8	64.9	62.2
6400	66.4	65.6	65.5	62.1
6500	65.3	64.3	65.2	61.0
6600	65.6	65.0	65.5	60.0
6700	61.2	63.4	63.7	58.1
6800	63.3	65.1	64.2	59.6
6900	62.6	64.5	61.1	57.5
7055	61.9	63.3	60.7	56.7
7125	61.2	62.1	61.7	55.1
Average	65.0	62.3	64.1	61.2

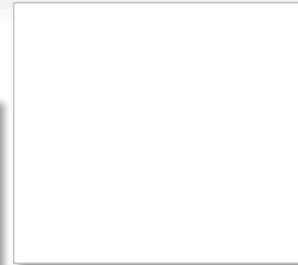
Antenna Peak Realized Gain– 6 GHz Wi-Fi Antennas



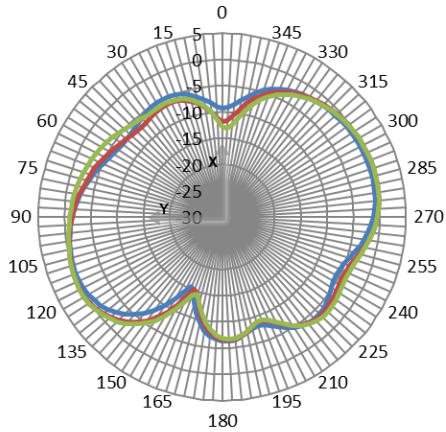
Frequency (MHz)	Ant6_6G (dBi)	Ant7_6G (dBi)	Ant8_6G (dBi)	Ant9_6G (dBi)
5500	4.6	3.5	4.8	5.5
5600	4.7	3.1	4.6	5.4
5700	4.5	3.6	5.3	5.3
5785	4.6	3.9	5.3	5.8
5800	4.8	3.7	5.4	6.0
5850	4.9	3.8	5.3	5.9
5925	5.0	4.1	5.6	5.9
6000	4.6	4.2	5.6	5.5
6100	4.5	4.0	5.5	5.3
6195	4.9	4.1	5.4	5.4
6300	4.5	4.8	5.2	5.5
6400	4.4	5.1	5.5	5.9
6500	4.0	4.9	5.6	5.9
6600	3.9	5.2	5.6	5.7
6700	4.0	4.5	4.8	5.4
6800	4.7	4.4	4.6	5.5
6900	4.7	4.4	4.7	5.6
7055	4.9	4.3	4.8	5.7
7125	5.3	4.4	5.0	5.8

Radiation Patterns

Total Gain Patterns: Ant1_2G4



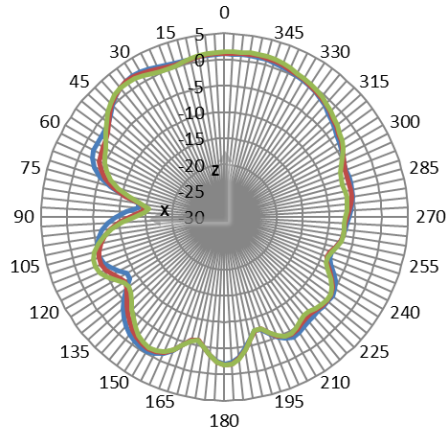
Ant1_2G4 Azimuth XY



— 2412MHz: Max=-0.11 Avg=-3.53
— 2440MHz: Max=0.47 Avg=-3.19
— 2462MHz: Max=0.51 Avg=-2.96

Azimuth (XY)

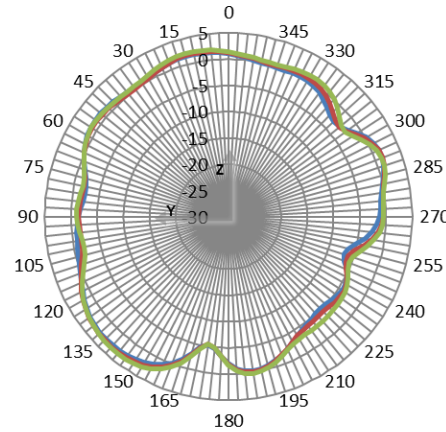
Ant1_2G4 Elevation XZ



— 2412MHz: Max=2.17 Avg=-2.33
— 2440MHz: Max=1.91 Avg=-2.45
— 2462MHz: Max=1.74 Avg=-2.49

Side to Side (XZ)

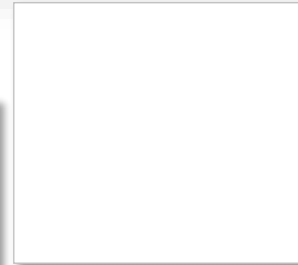
Ant1_2G4 Elevation YZ



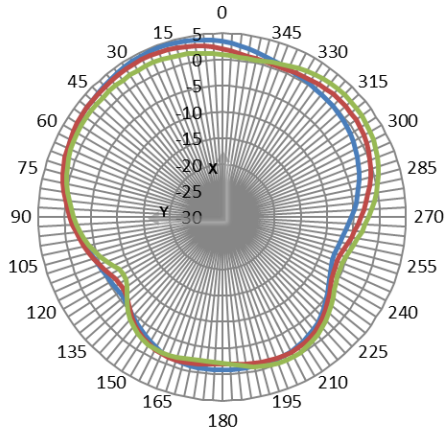
— 2412MHz: Max=2.95 Avg=-0.29
— 2440MHz: Max=3.31 Avg=-0.11
— 2462MHz: Max=3.57 Avg=0.15

Front to Back (YZ)

Total Gain Patterns: Ant3_2G4



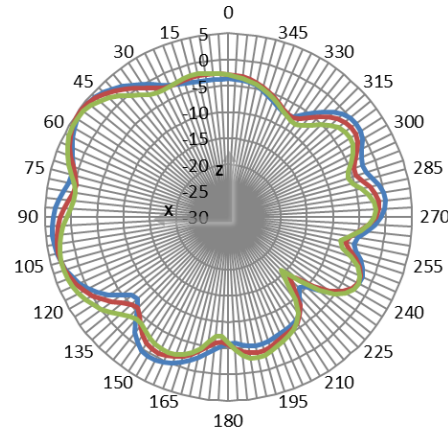
Ant3_2G4 Azimuth XY



— 2412MHz: Max=4.47 Avg=-0.06
— 2440MHz: Max=3.69 Avg=0.03
— 2462MHz: Max=2.97 Avg=-0.06

Azimuth (XY)

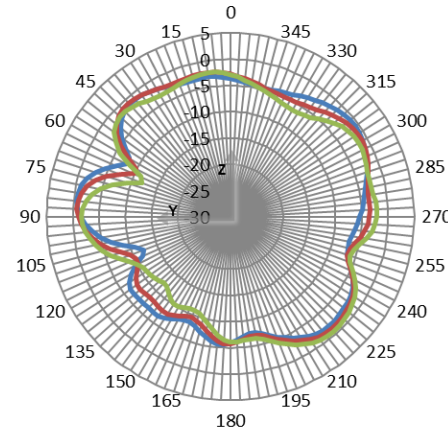
Ant3_2G4 Elevation XZ



— 2412MHz: Max=4.59 Avg=-0.74
— 2440MHz: Max=4.71 Avg=-1.13
— 2462MHz: Max=4.43 Avg=-1.34

Side to Side (XZ)

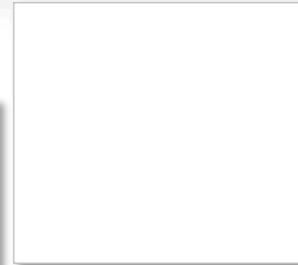
Ant3_2G4 Elevation YZ



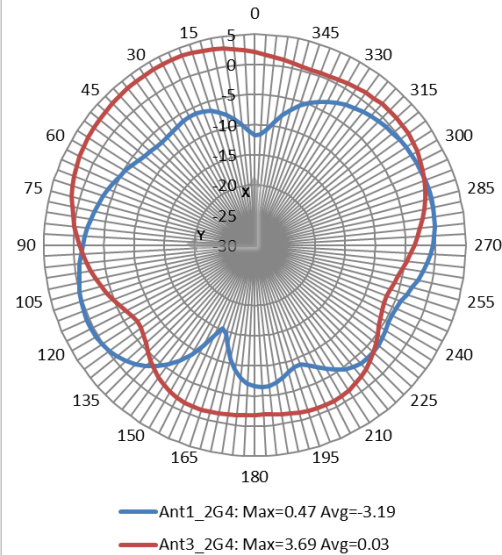
— 2412MHz: Max=-0.57 Avg=-3.78
— 2440MHz: Max=-0.74 Avg=-3.70
— 2462MHz: Max=-0.61 Avg=-3.97

Front to Back (YZ)

Coverage Total Gain Patterns: Wi-Fi Antennas at 2440MHz

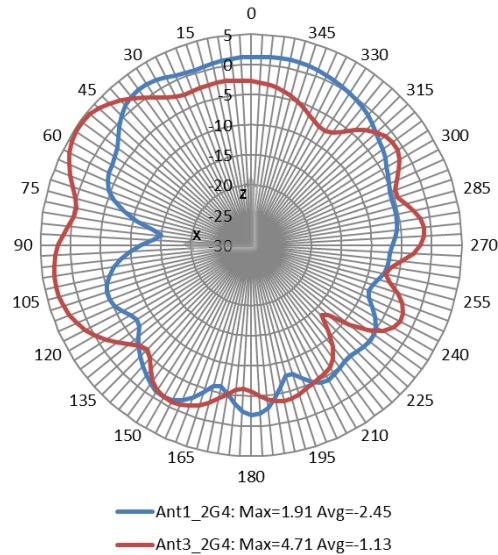


Azimuth XY 2440MHz



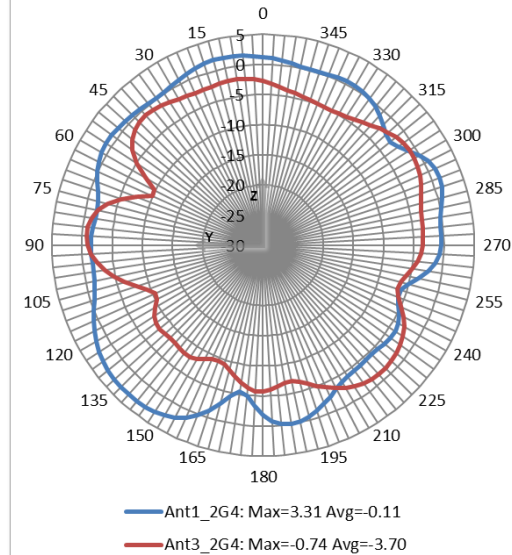
Azimuth (XY)

Elevation XZ 2440MHz



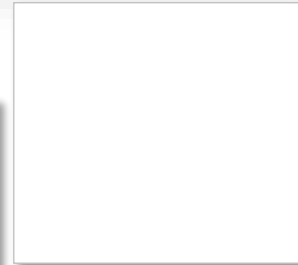
Front to Back (XZ)

Elevation YZ 2440MHz

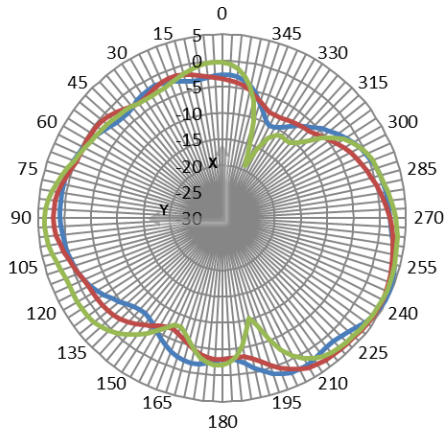


Side to Side (YZ)

Total Gain Patterns: Ant2_5G



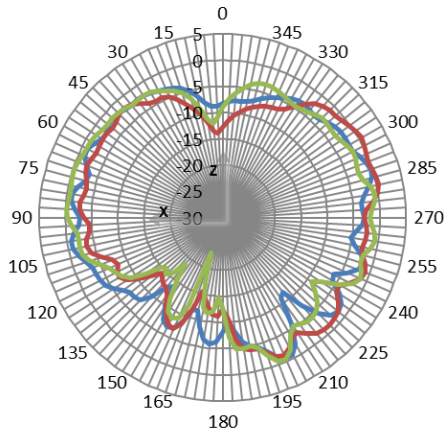
Ant2_5G Azimuth XY



— 5180MHz: Max=4.83 Avg=-0.24
— 5500MHz: Max=4.36 Avg=-0.18
— 5785MHz: Max=4.26 Avg=0.37

Azimuth (XY)

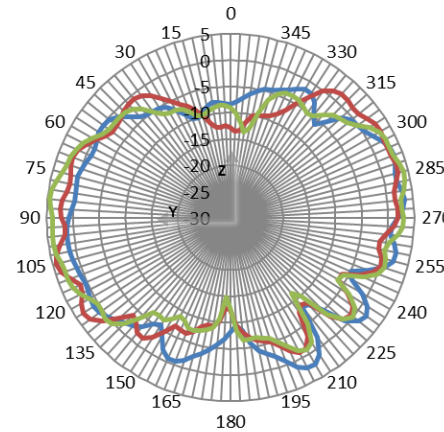
Ant2_5G Elevation XZ



— 5180MHz: Max=-0.32 Avg=-3.65
— 5500MHz: Max=0.51 Avg=-3.68
— 5785MHz: Max=-0.10 Avg=-3.53

Side to Side (XZ)

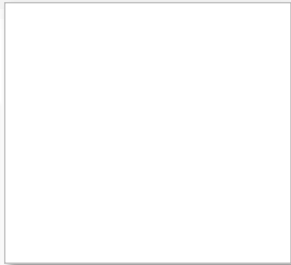
Ant2_5G Elevation YZ



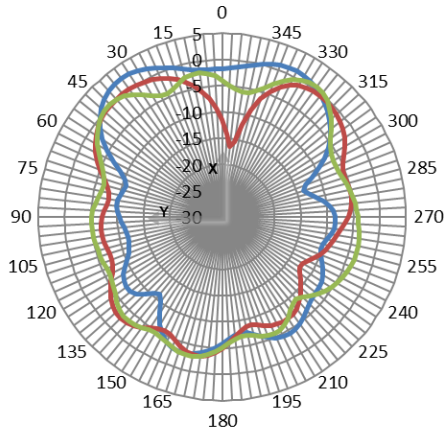
— 5180MHz: Max=3.30 Avg=-0.89
— 5500MHz: Max=4.31 Avg=-0.71
— 5785MHz: Max=4.53 Avg=-0.45

Front to Back (YZ)

Total Gain Patterns: Ant5_5G



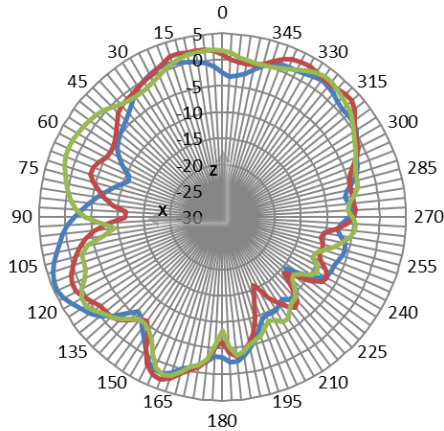
Ant5_5G Azimuth XY



— 5180MHz: Max=2.58 Avg=-3.42
— 5500MHz: Max=0.19 Avg=-4.24
— 5785MHz: Max=0.67 Avg=-3.73

Azimuth (XY)

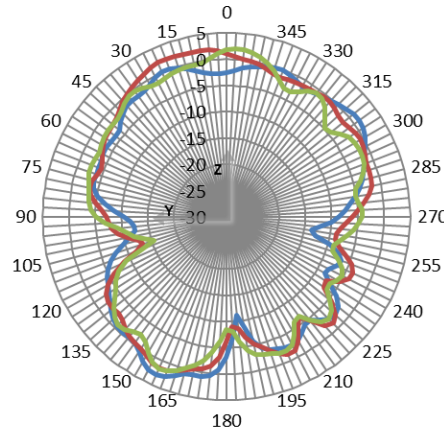
Ant5_5G Elevation XZ



— 5180MHz: Max=4.46 Avg=-1.34
— 5500MHz: Max=3.25 Avg=-1.33
— 5785MHz: Max=3.18 Avg=-1.07

Side to Side (XZ)

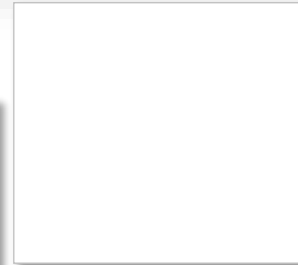
Ant5_5G Elevation YZ



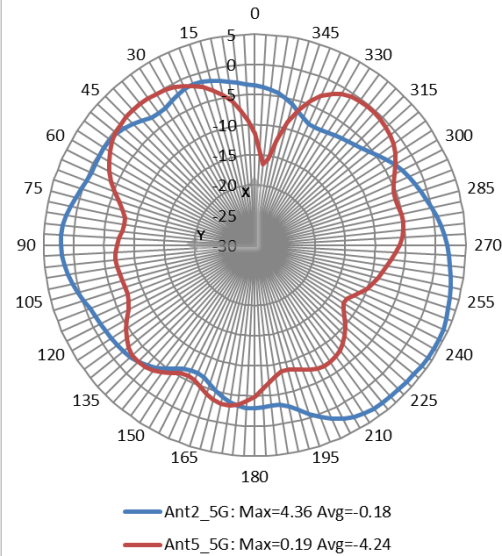
— 5180MHz: Max=3.04 Avg=-2.13
— 5500MHz: Max=2.20 Avg=-1.73
— 5785MHz: Max=2.07 Avg=-2.39

Front to Back (YZ)

Coverage Total Gain Patterns: Wi-Fi Antennas at 5500MHz

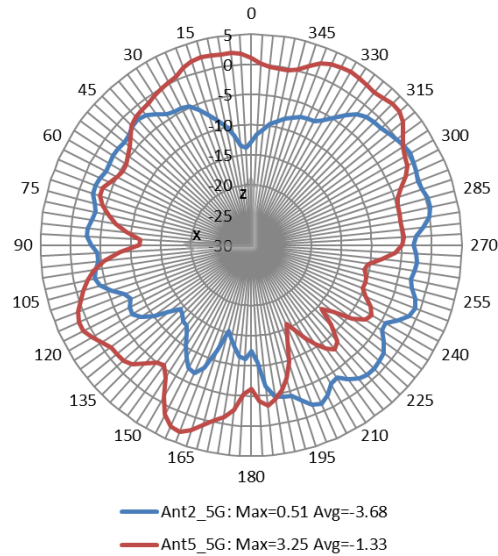


Azimuth XY 5500MHz



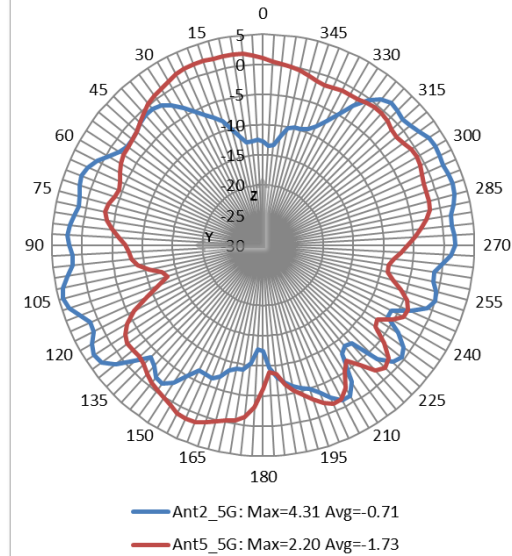
Azimuth (XY)

Elevation XZ 5500MHz



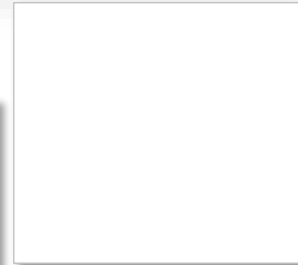
Front to Back (XZ)

Elevation YZ 5500MHz

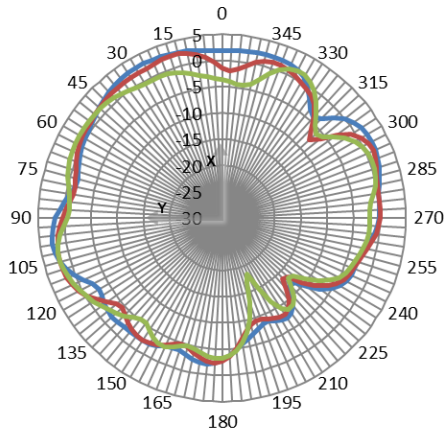


Side to Side (YZ)

Total Gain Patterns: Ant6_6G



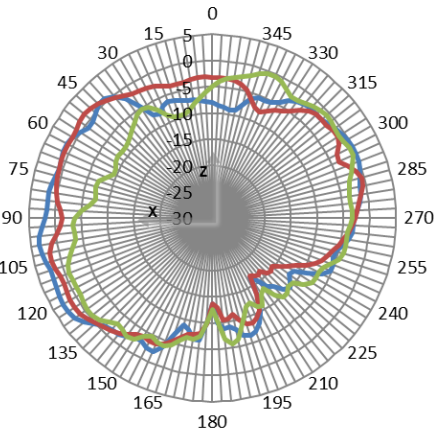
Ant6_6G Azimuth XY



— 6195MHz: Max=3.03 Avg=-0.17
— 6500MHz: Max=2.39 Avg=-0.83
— 7055MHz: Max=2.01 Avg=-1.58

Azimuth (XY)

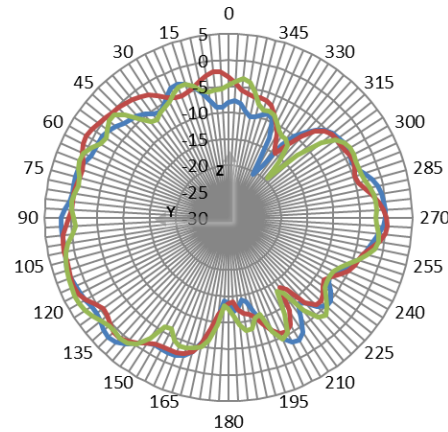
Ant6_6G Elevation XZ



— 6195MHz: Max=3.45 Avg=-1.82
— 6500MHz: Max=1.71 Avg=-2.37
— 7055MHz: Max=-0.40 Avg=-4.05

Side to Side (XZ)

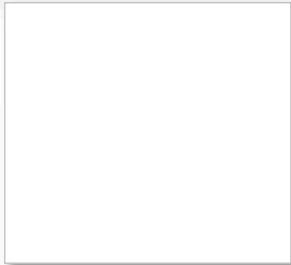
Ant6_6G Elevation YZ



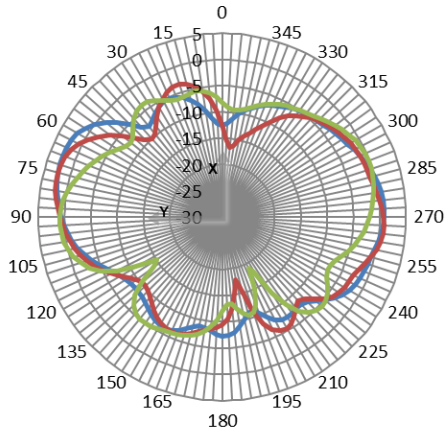
— 6195MHz: Max=2.32 Avg=-2.39
— 6500MHz: Max=2.27 Avg=-2.29
— 7055MHz: Max=2.79 Avg=-2.64

Front to Back (YZ)

Total Gain Patterns: Ant7_6G



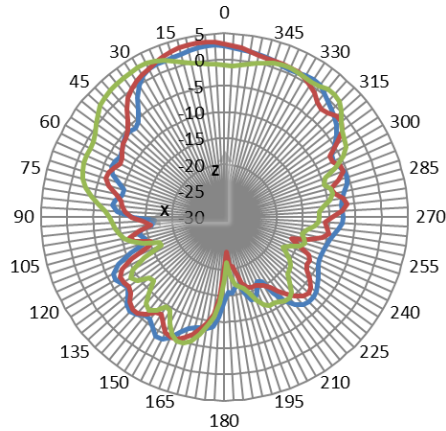
Ant7_6G Azimuth XY



— 6195MHz: Max=2.59 Avg=-2.94
 — 6500MHz: Max=2.47 Avg=-3.30
 — 7055MHz: Max=0.96 Avg=-4.11

Azimuth (XY)

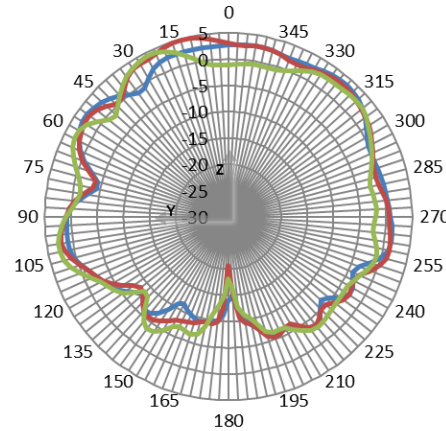
Ant7_6G Elevation XZ



— 6195MHz: Max=2.87 Avg=-3.32
 — 6500MHz: Max=3.67 Avg=-3.20
 — 7055MHz: Max=2.95 Avg=-2.94

Side to Side (XZ)

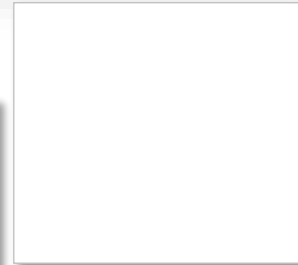
Ant7_6G Elevation YZ



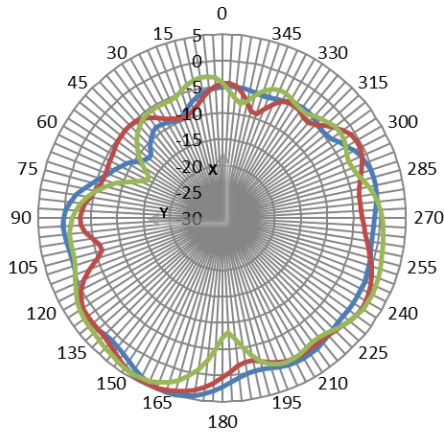
— 6195MHz: Max=3.61 Avg=-0.11
 — 6500MHz: Max=4.83 Avg=0.30
 — 7055MHz: Max=4.25 Avg=-0.46

Front to Back (YZ)

Total Gain Patterns: Ant8_6G



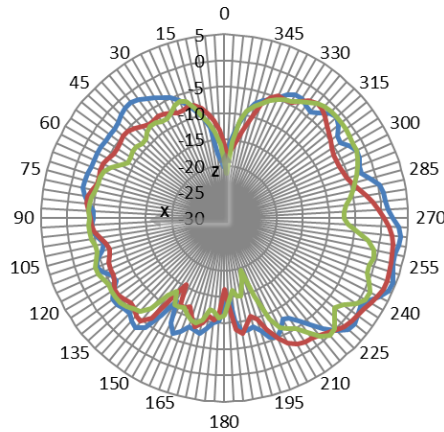
Ant8_6G Azimuth XY



— 6195MHz: Max=4.91 Avg=-0.55
— 6500MHz: Max=4.72 Avg=-0.97
— 7055MHz: Max=4.26 Avg=-0.79

Azimuth (XY)

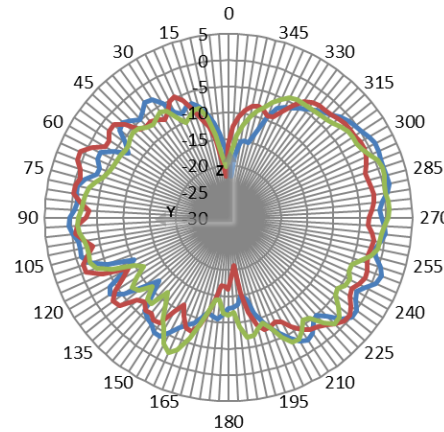
Ant8_6G Elevation XZ



— 6195MHz: Max=4.40 Avg=-2.33
— 6500MHz: Max=3.34 Avg=-3.38
— 7055MHz: Max=1.14 Avg=-4.68

Side to Side (XZ)

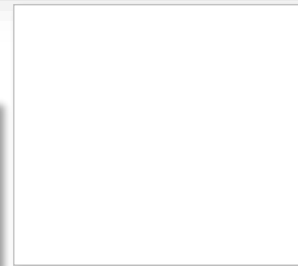
Ant8_6G Elevation YZ



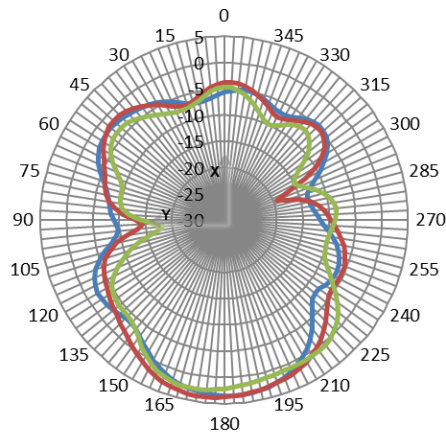
— 6195MHz: Max=1.26 Avg=-3.10
— 6500MHz: Max=0.83 Avg=-3.82
— 7055MHz: Max=0.92 Avg=-4.13

Front to Back (YZ)

Total Gain Patterns: Ant9_6G



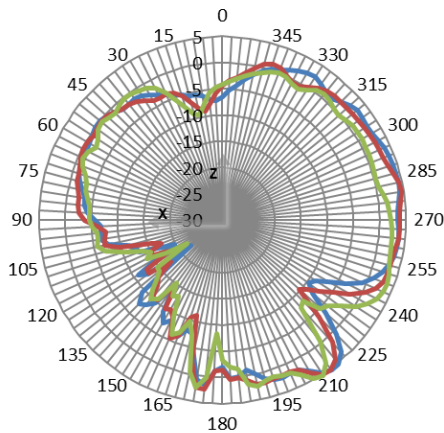
Ant9_6G Azimuth XY



— 6195MHz: Max=3.51 Avg=-2.64
— 6500MHz: Max=3.91 Avg=-2.08
— 7055MHz: Max=2.64 Avg=-3.28

Azimuth (XY)

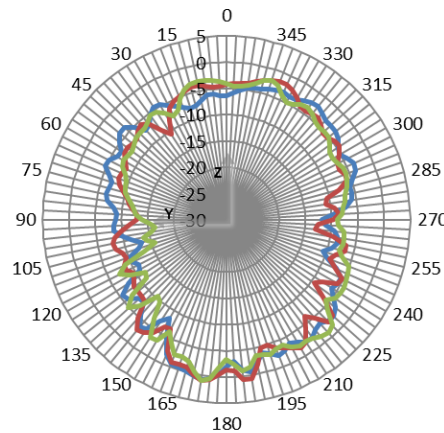
Ant9_6G Elevation XZ



— 6195MHz: Max=5.39 Avg=-0.02
— 6500MHz: Max=5.30 Avg=-0.02
— 7055MHz: Max=5.31 Avg=-0.78

Side to Side (XZ)

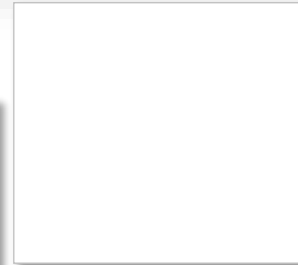
Ant9_6G Elevation YZ



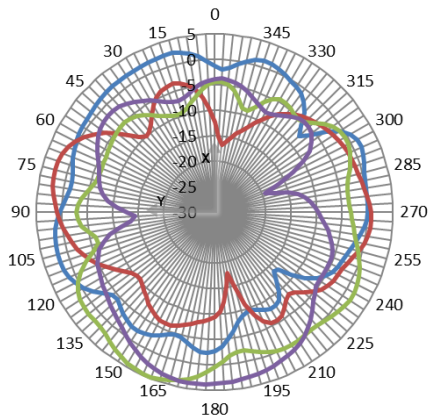
— 6195MHz: Max=0.79 Avg=-4.48
— 6500MHz: Max=0.99 Avg=-4.71
— 7055MHz: Max=1.00 Avg=-4.85

Front to Back (YZ)

Coverage Total Gain Patterns: Wi-Fi Antennas at 6500MHz



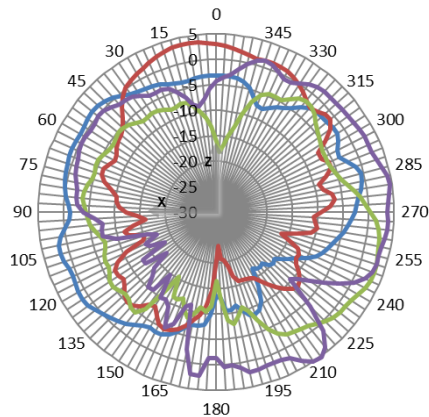
Azimuth XY 6500MHz



- Ant6_6G: Max=2.39 Avg=-0.83
- Ant7_6G: Max=2.47 Avg=-3.30
- Ant8_6G: Max=4.72 Avg=-0.97
- Ant9_6G: Max=3.91 Avg=-2.08

Azimuth (XY)

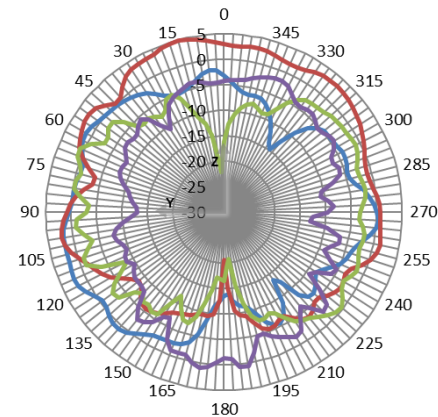
Elevation XZ 6500MHz



- Ant6_6G: Max=1.71 Avg=-2.37
- Ant7_6G: Max=3.67 Avg=-3.20
- Ant8_6G: Max=3.34 Avg=-3.38
- Ant9_6G: Max=5.30 Avg=-0.02

Front to Back (XZ)

Elevation YZ 6500MHz



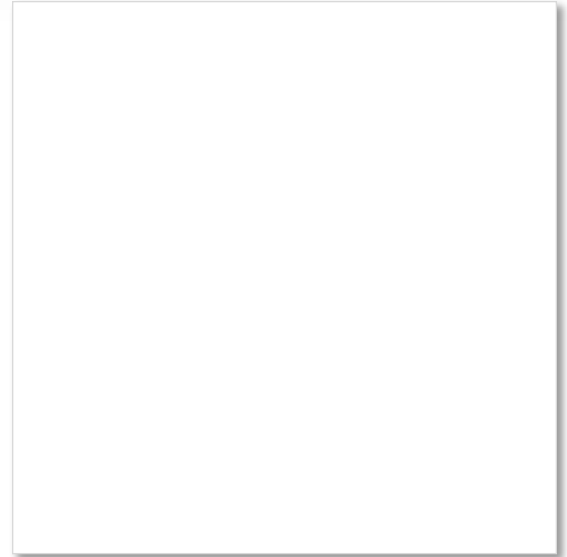
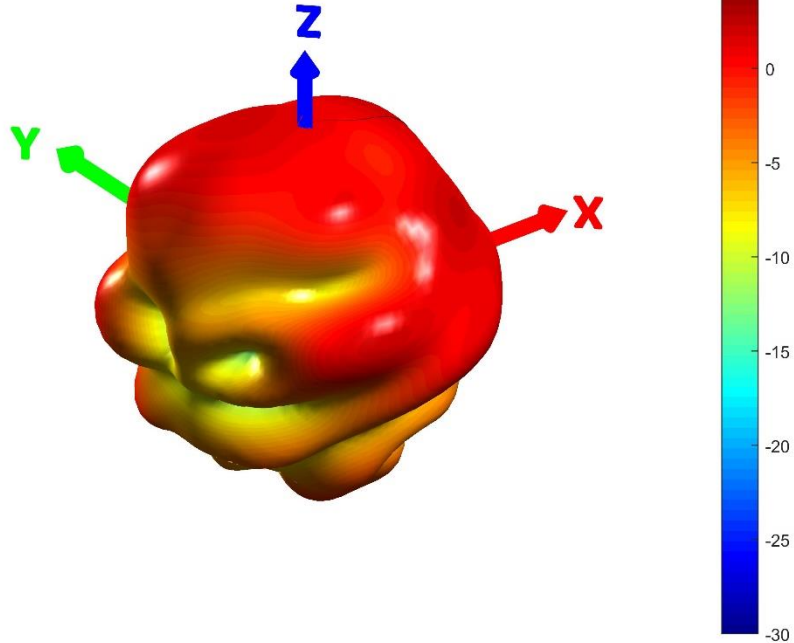
- Ant6_6G: Max=2.27 Avg=-2.29
- Ant7_6G: Max=4.83 Avg=0.30
- Ant8_6G: Max=0.83 Avg=-3.82
- Ant9_6G: Max=0.99 Avg=-4.71

Side to Side (YZ)

Total Gain 3D Pattern: Ant1_2G4 at 2440MHz



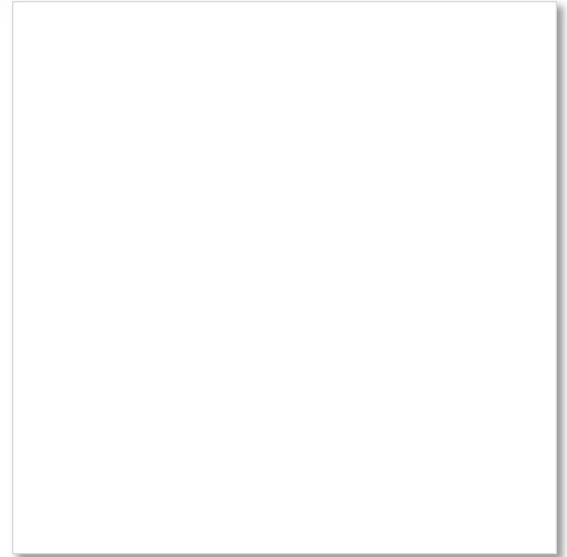
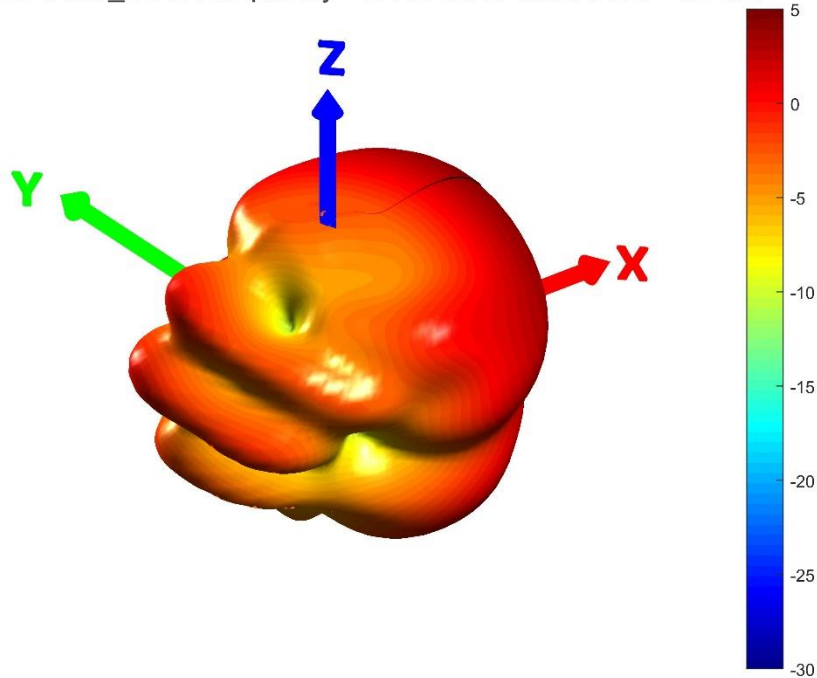
WX5610 B0 Ant1_2G4: Frequency = 2440 MHz Max Gain= 3.6 dBi



Total Gain 3D Pattern: Ant3_2G4 at 2440MHz



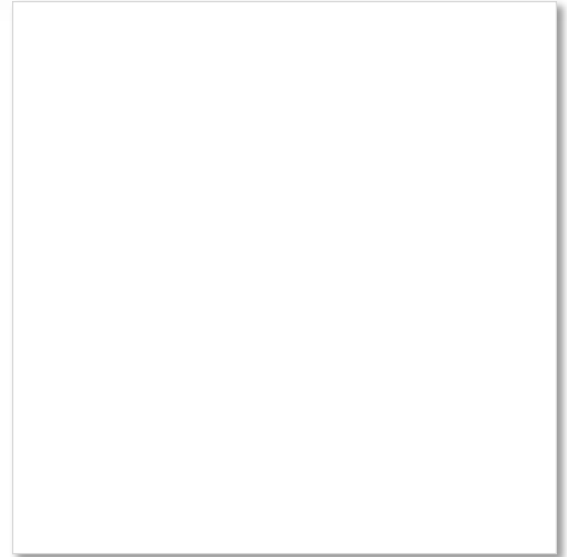
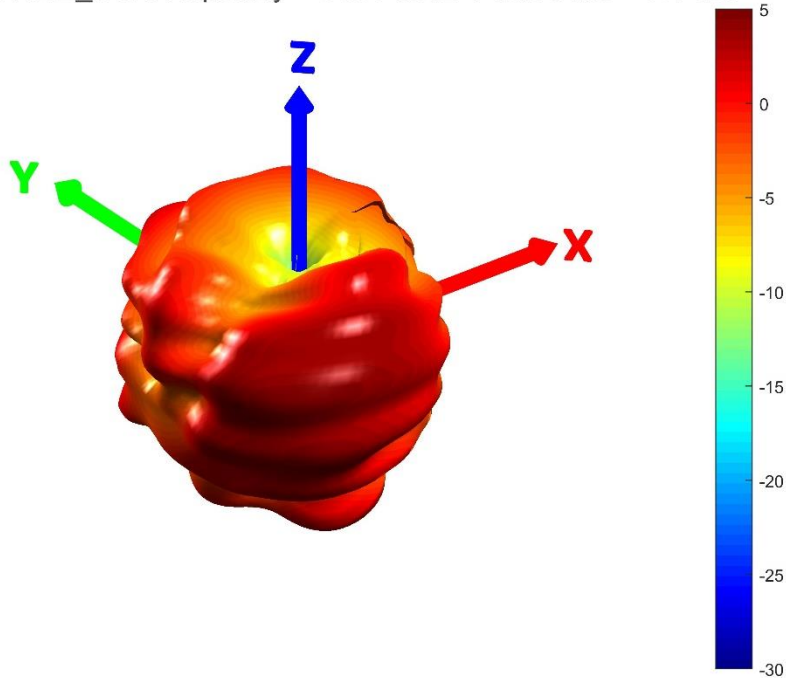
WX5610 B0 Ant3_2G4: Frequency = 2440 MHz Max Gain= 4.8 dBi



Total Gain 3D Pattern: Ant2_5G at 5500MHz



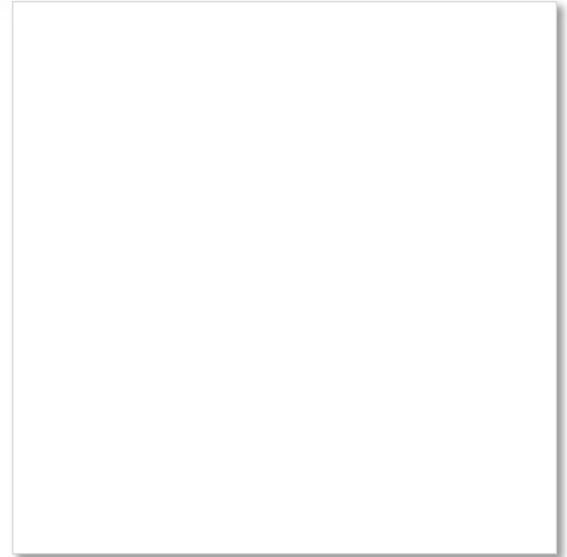
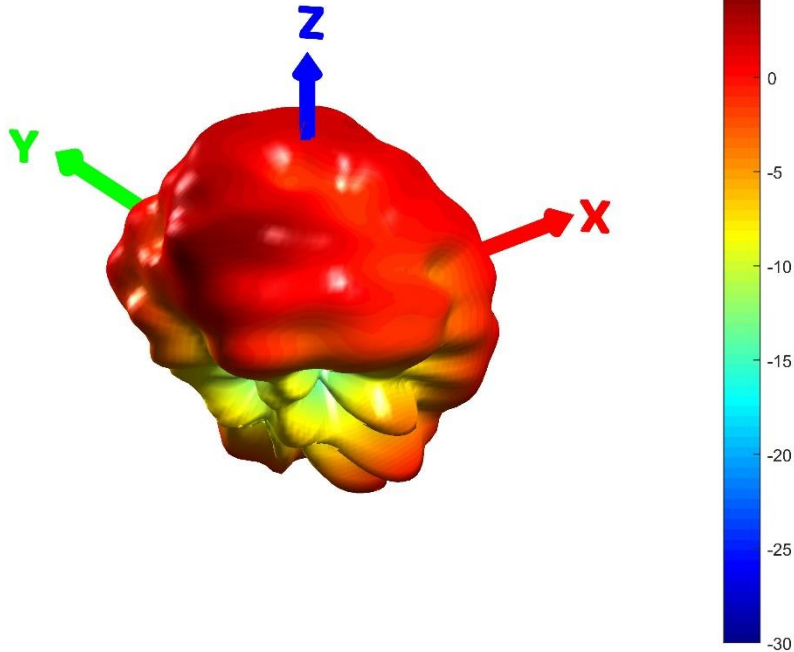
WX5610 B0 Ant2_5G: Frequency = 5500 MHz Peak Gain = 5.1 dBi



Total Gain 3D Pattern: Ant5_5G at 5500MHz



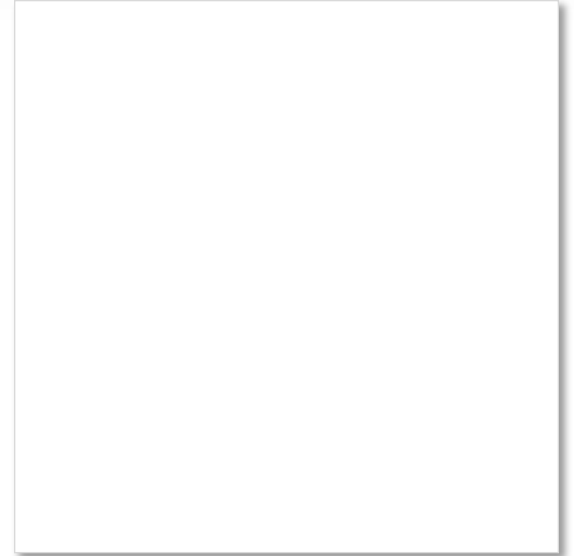
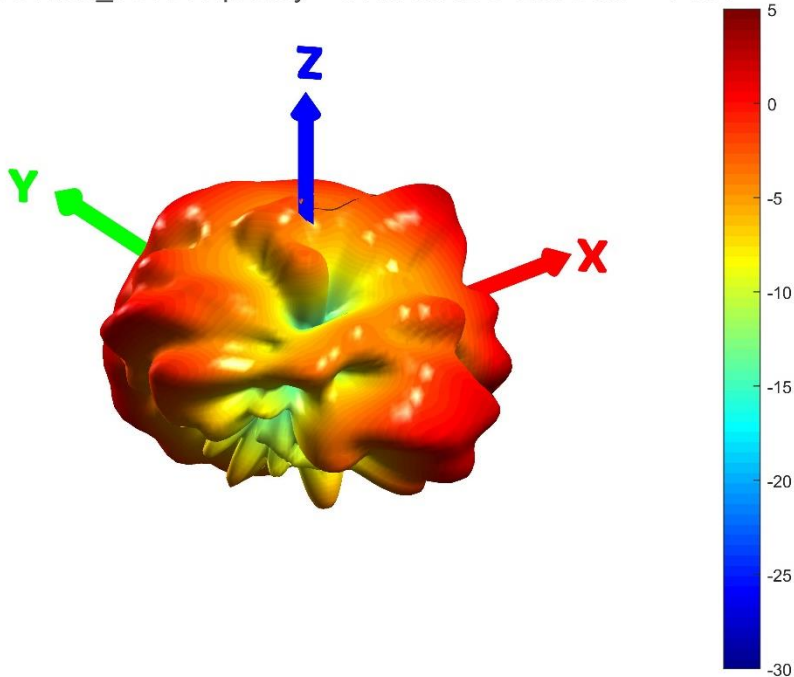
WX5610 B0 Ant5_5G: Frequency = 5500 MHz Peak Gain = 4.4 dBi



Total Gain 3D Pattern: Ant6_6G at 6500MHz



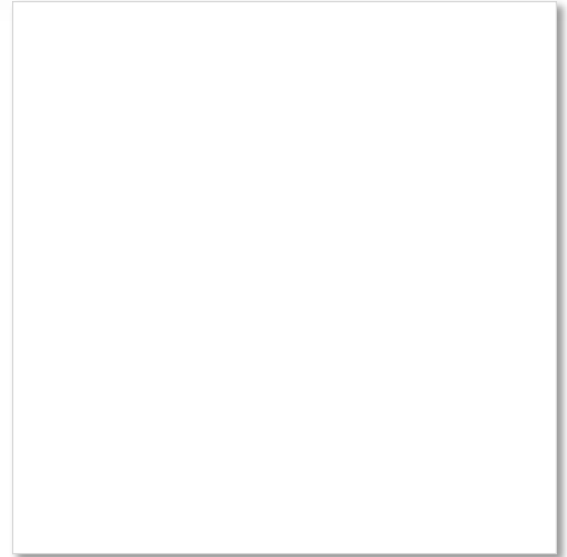
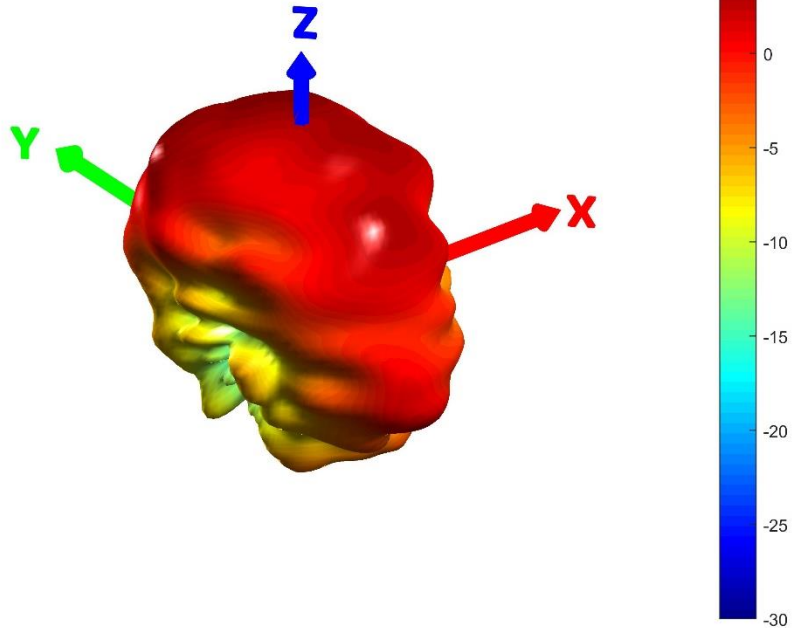
WX5610 B0 Ant6_6G: Frequency = 6500 MHz Peak Gain = 4 dBi



Total Gain 3D Pattern: Ant7_6G at 6500MHz



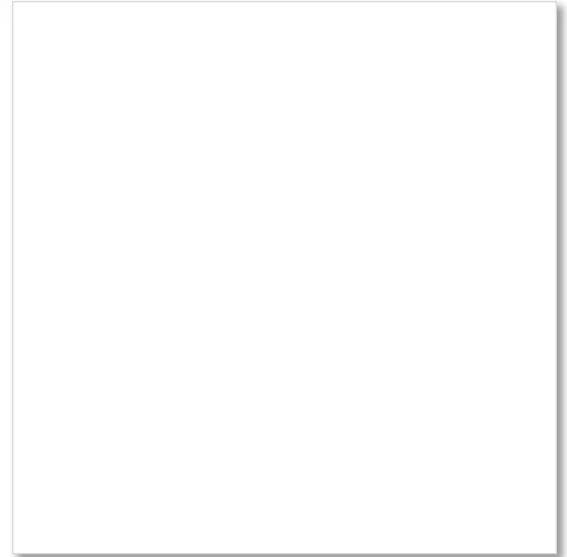
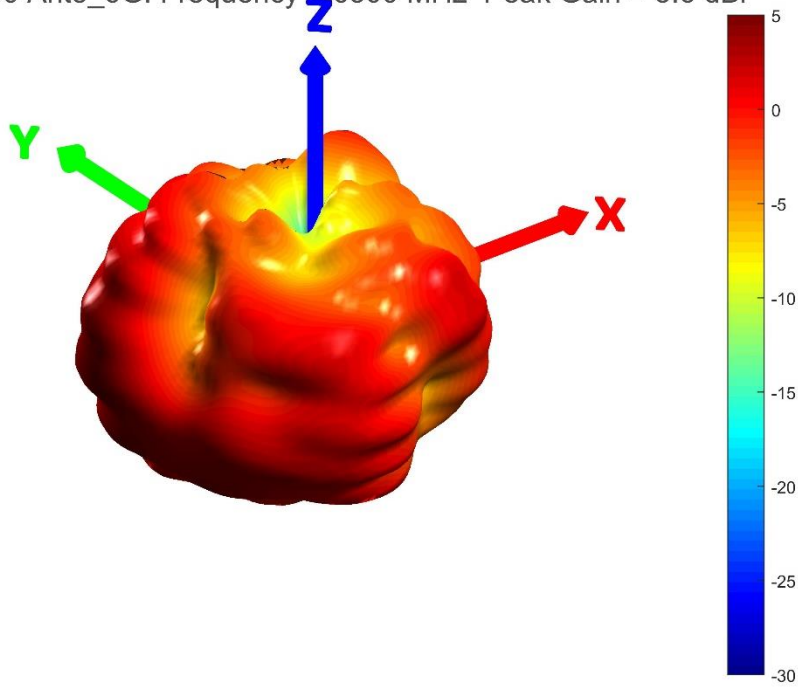
WX5610 B0 Ant7_6G: Frequency = 6500 MHz Peak Gain = 4.9 dBi



Total Gain 3D Pattern: Ant8_6G at 6500MHz



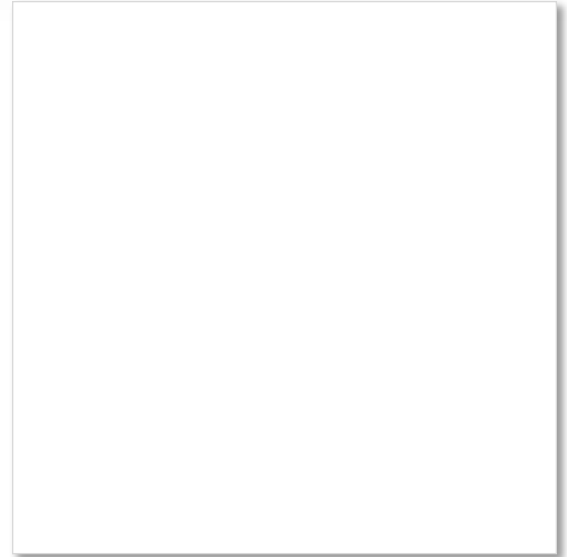
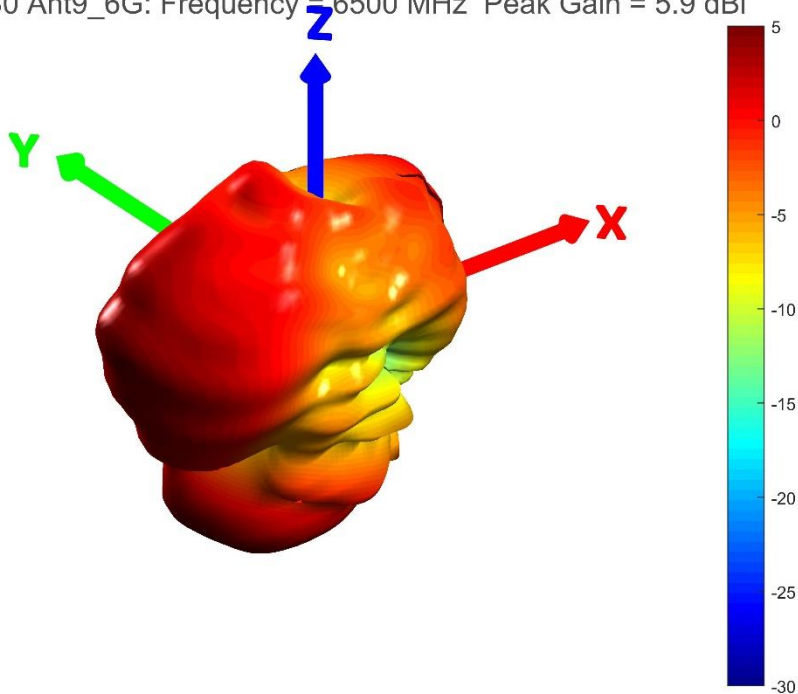
WX5610 B0 Ant8_6G: Frequency = 6500 MHz Peak Gain = 5.6 dBi



Total Gain 3D Pattern: Ant9_6G at 6500MHz



WX5610 B0 Ant9_6G: Frequency = 6500 MHz Peak Gain = 5.9 dBi



- Return loss < -10dB
- Isolation < -20dB
- Efficiency :
- 2G band >67%, 5G band>62%, 6G band>55%
- 2.4GHz < 4.9 dBi, 5GHz < 5.3 dBi, 6GHz < 6 dBi