



Customer Name & Project: XM4 v13.3

Prepared By: China team

Date: 9th September 2025

Airgain Project Code:

- Airgain proposes an embedded antenna solution for XM4
 - The antenna solution is updated based upon the latest device provided by August 8th, 2025

- Total 2 antennas need to be integrated into limited housing space:
 - WIFI 5G antennas *2
 - Ant1 Frequency Range : 5150-5850 (MHz);
 - Ant2 Frequency Range : 5150-5850 (MHz);
- The antenna is mounted on the plastic enclosure and connect to the radio through coaxial cable and I-PEX EQ Connector
- Passive measurement results are presented

Airgain Antenna Measurement System

Test Information

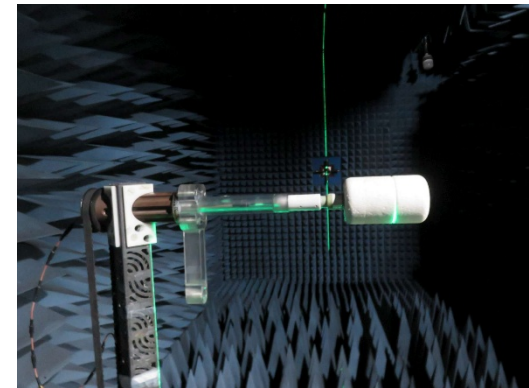
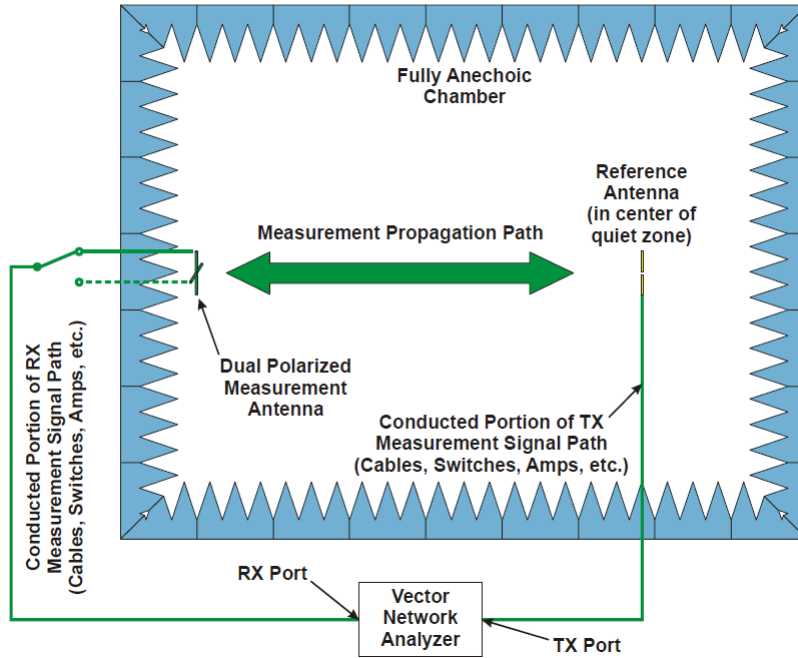


Item	Description
Brand Name	Comcast
Equipment	XM4
Test Location	No.1098, Pengxi North Road, Kunshan City, Suzhou City, Jiangsu Province
Test Date	September 5, 2025
Test Condition	Radiation
Test Engineer	Zhou Xing chi
Test Environment Test Software	ETS AMS8500 EMQuest
CTIA lab code	20071213-00
VNA	KEYSIGHT E5071C
Calibration Time	April 16, 2025 - April 15, 2026



1. Fix the DUT on the dielectric support structure and connect the feeding cable to the antenna used for test
2. Set measurement parameters such as frequency range and sampling angle
3. Perform test and then get far-field data (radiation pattern, gain, efficiency)
4. Repeat test procedure for other antennas

Network analyzer and reference antennas are used for calibration. Path loss and cable loss for different frequency bands can be checked and calculated.



Airgain Antenna System Proposal

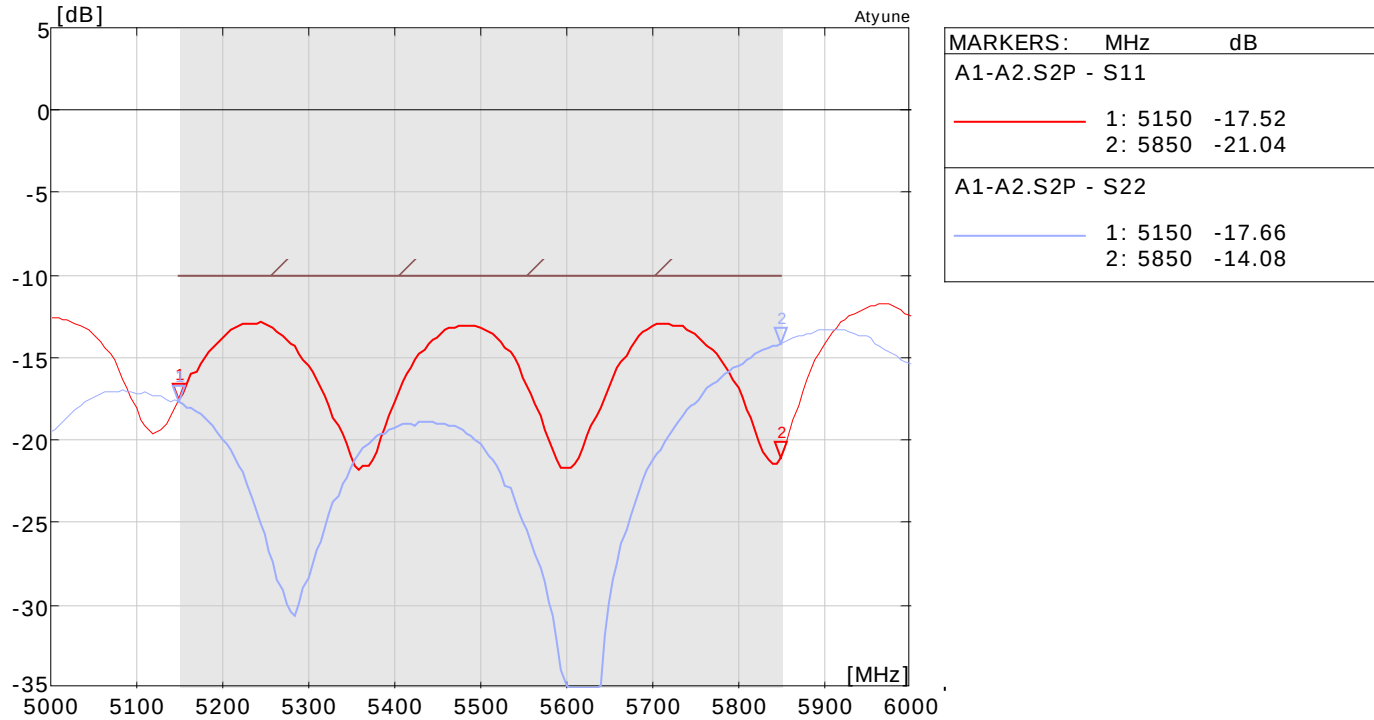
Antenna System Proposal(Original Antennas Solution)



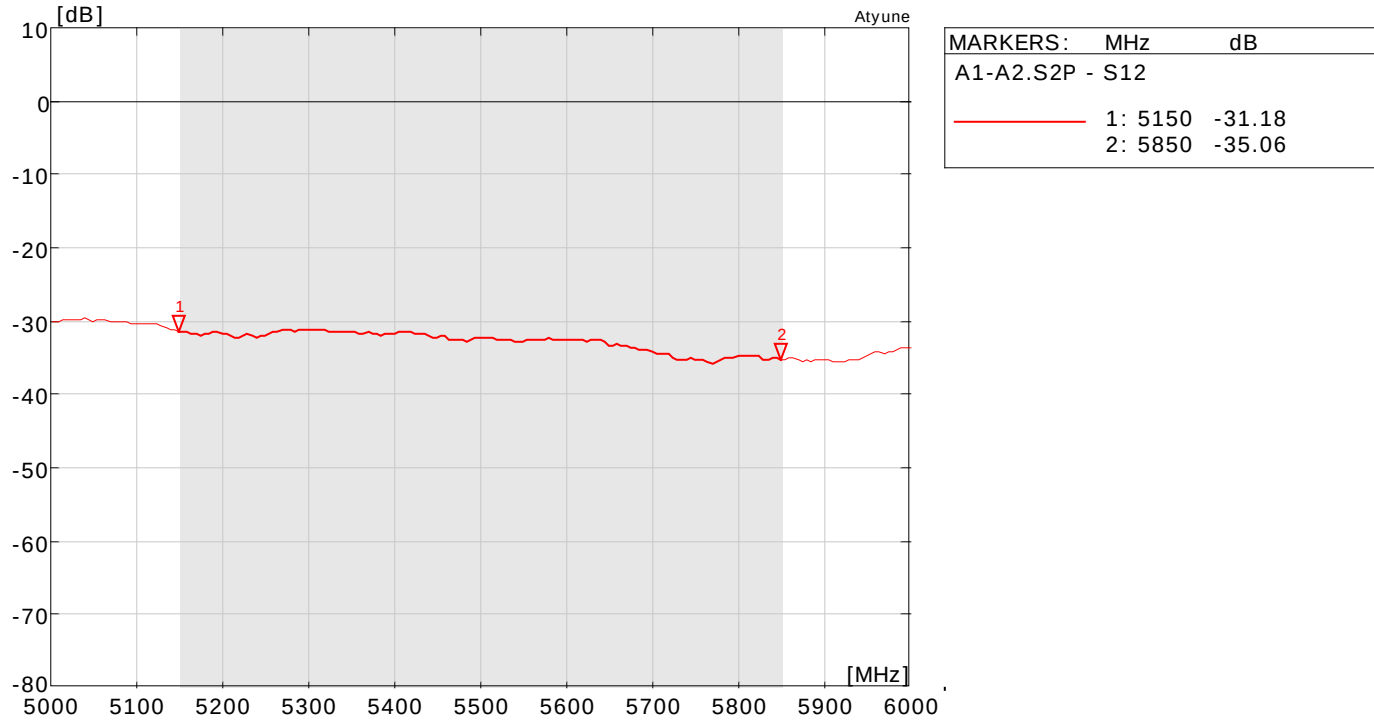
Antenna #	Part Number
Ant1_5G	N02SMBBC-PK1-LG1X420BU
Ant2_5G	N02SMBBD-PK1-LG1X230BU

S-Parameters

Reflection Coefficient for 5G Antennas



Isolation for 5G Antennas



Efficiency and Peak Gain

Antenna Realized Efficiency & Peak Gain – 5 GHz Wi-Fi Antennas



Frequency (MHz)	Ant1_5G (%)	Ant2_5G (%)
5150	54.0	61.0
5200	54.2	59.0
5300	50.2	62.1
5400	53.9	64.7
5500	60.0	67.2
5600	56.4	63.6
5700	56.0	63.9
5800	55.2	59.4
5850	58.7	59.2
Average	55.4	62.2

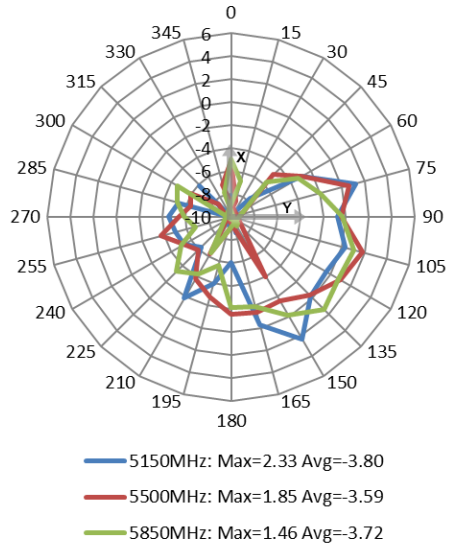
Frequency (MHz)	Ant1_5G (dBi)	Ant2_5G (dBi)
5150	2.3	2.9
5200	2.0	2.4
5300	1.9	2.5
5400	2.6	2.5
5500	3.2	3.3
5600	2.7	3.4
5700	2.3	3.7
5800	2.5	2.9
5850	2.6	3.1

Radiation Patterns

Total Gain Patterns: Ant1_5G

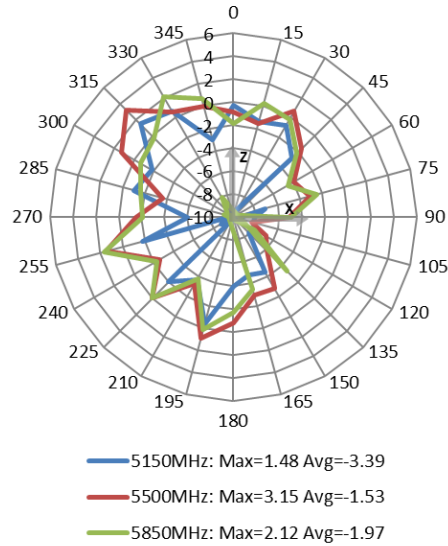


Ant1_5G Azimuth XY



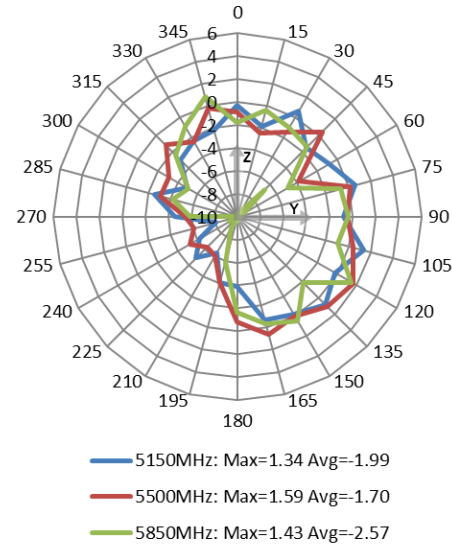
Azimuth (XY)

Ant1_5G Elevation XZ



Side to Side (XZ)

Ant1_5G Elevation YZ

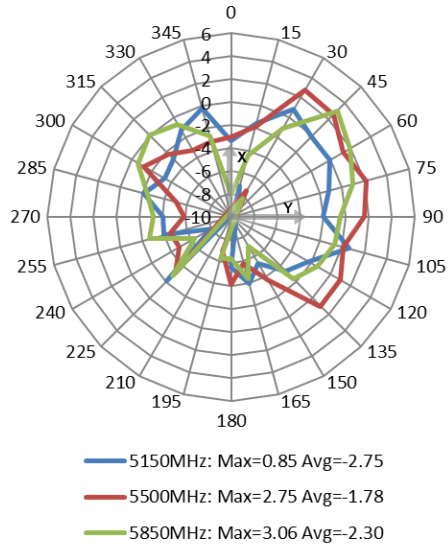


Front to Back (YZ)

Total Gain Patterns: Ant2_5G

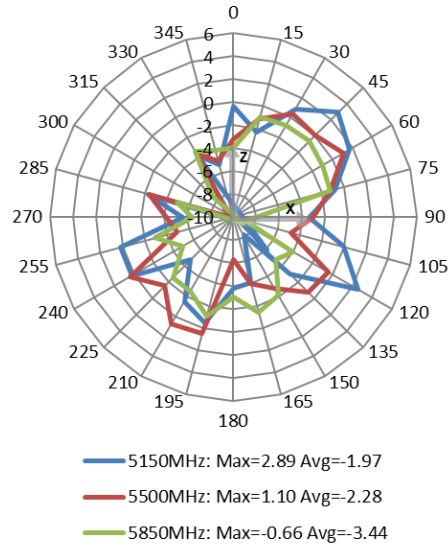


Ant2_5G Azimuth XY



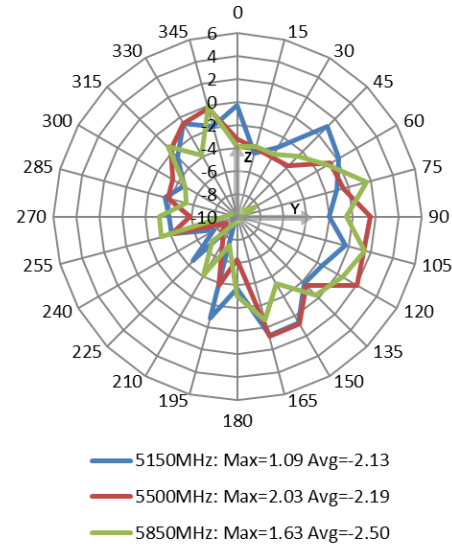
Azimuth (XY)

Ant2_5G Elevation XZ



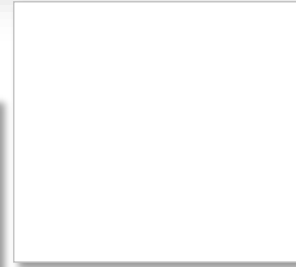
Side to Side (XZ)

Ant2_5G Elevation YZ

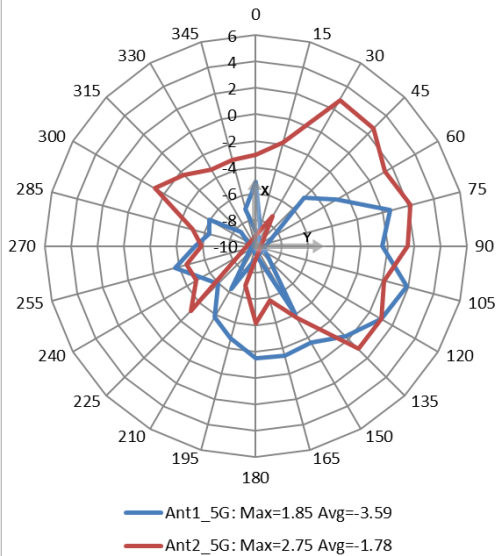


Front to Back (YZ)

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

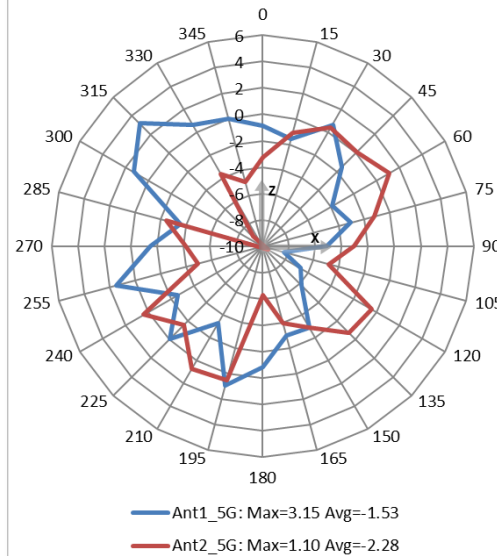


Azimuth XY 5500MHz



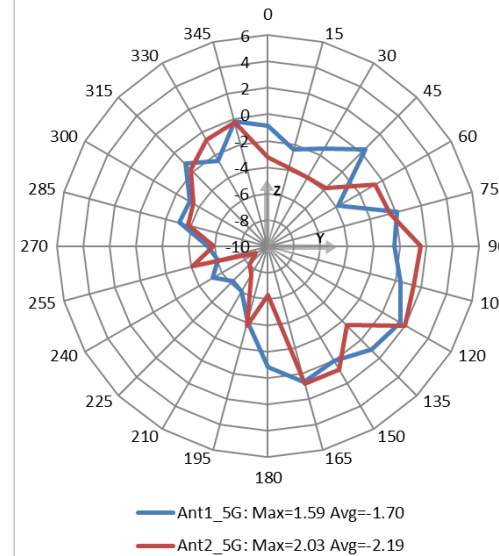
Azimuth (XY)

Elevation XZ 5500MHz



Side to Side (XZ)

Elevation YZ 5500MHz



Front to Back (YZ)

System Composite Gain

- The composite gain is based on FCC document 662911. Part d (ii)

d) *Unequal antenna gains, with equal transmit powers.* For antenna gains given by $G_1, G_2, \dots, G_N$ dBi

- (i) If transmit signals are *correlated*, then

Directional gain = $10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{\text{ANT}}]$ dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

- (ii) If all transmit signals are *completely uncorrelated*, then

Directional gain = $10 \log[(10^{G_1/10} + 10^{G_2/10} + \dots + 10^{G_N/10}) / N_{\text{ANT}}]$ dBi

Reference: FCC document, “Emissions Testing of Transmitters with Multiple Outputs in the Same Band”, 662911 D01 Multiple Transmitter Output v02r01

Composite Gain Calculation



Band	Phi°	Theta°	Ant1	Ant2	Calculated Correlated Directional Gain
NII-1	30°	0°	-0.46	-0.35	2.6
NII-2A	105°	120°	-3.4	1.27	2.3
NII-2C	120°	135°	-1.64	1.13	2.9
NII-3	120°	75°	0.84	-1.42	2.8

Step 1) For each antenna, measure the Theta / Phi radiation pattern.

Step 2) At each Theta / Phi coordinate, calculate the sum of all the antenna gains for Ant1+2 using the appropriate correlated formula for directional gain from KDB 662911 D01.

Step 3) The Table shows the Maximum direction gain calculated based on all the measurement coordinates of the 2x2 antenna system.

Antenna Realized Composite Gain– 5 GHz Wi-Fi Antennas



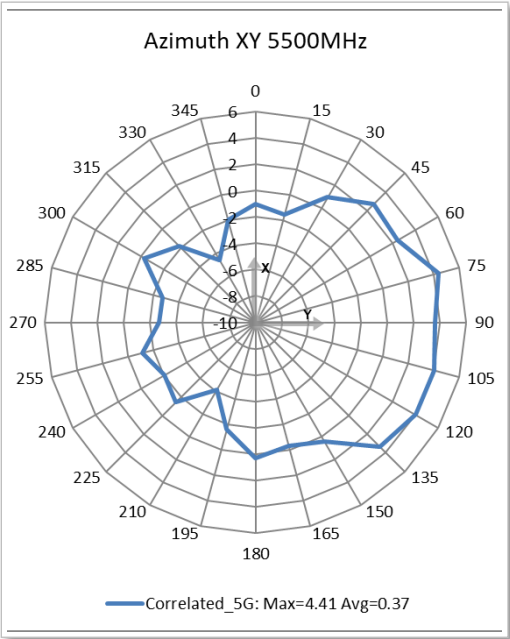
Ant1+Ant2

	Correlated Gain		Uncorrelated Gain	
Frequency (MHz)	Phi (dBi)	Theta (dBi)	Phi (dBi)	Theta (dBi)
5150	2.6	2.6	-0.4	-0.4
5200	2.1	2.0	-0.9	-1.0
5300	2.2	2.3	-0.8	-0.5
5400	2.5	2.6	-0.5	0.0
5500	2.4	2.8	-0.6	0.0
5600	1.8	2.4	-1.1	-0.4
5700	1.7	2.9	-0.9	0.0
5800	1.9	2.7	-0.8	-0.3
5850	2.8	2.2	-0.1	-0.4

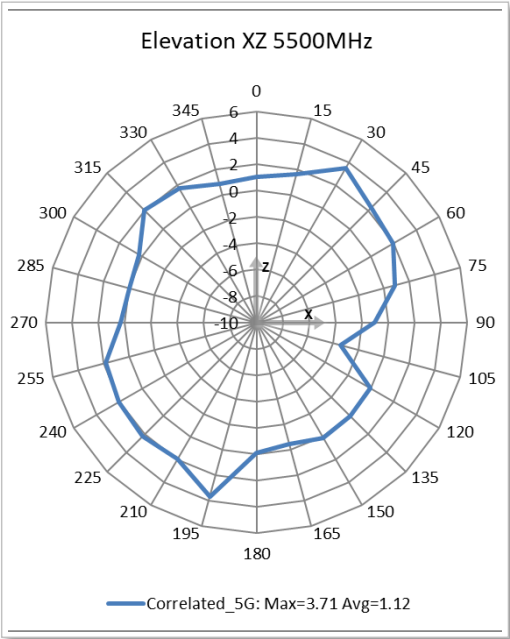
Maximum directional gain frequency at 5700MHz $\text{Directional Gain} = 10 \log \left(\frac{(10^{-1.64/20} + 10^{1.13/20})^2}{4} \right)$

Gain	Phi°	Theta°
2.9	120	135

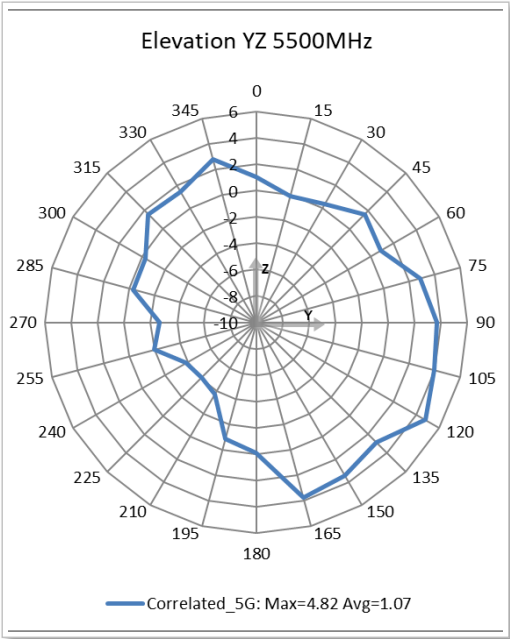
Correlated Composite Gain at 5.5GHz of Operation Total Gain 2D Cuts



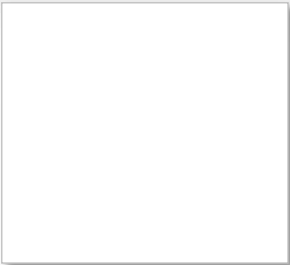
Azimuth (XY)



Side to Side (XZ)

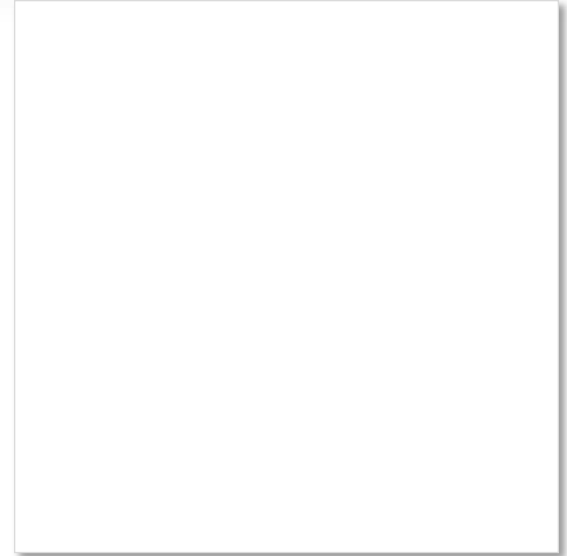
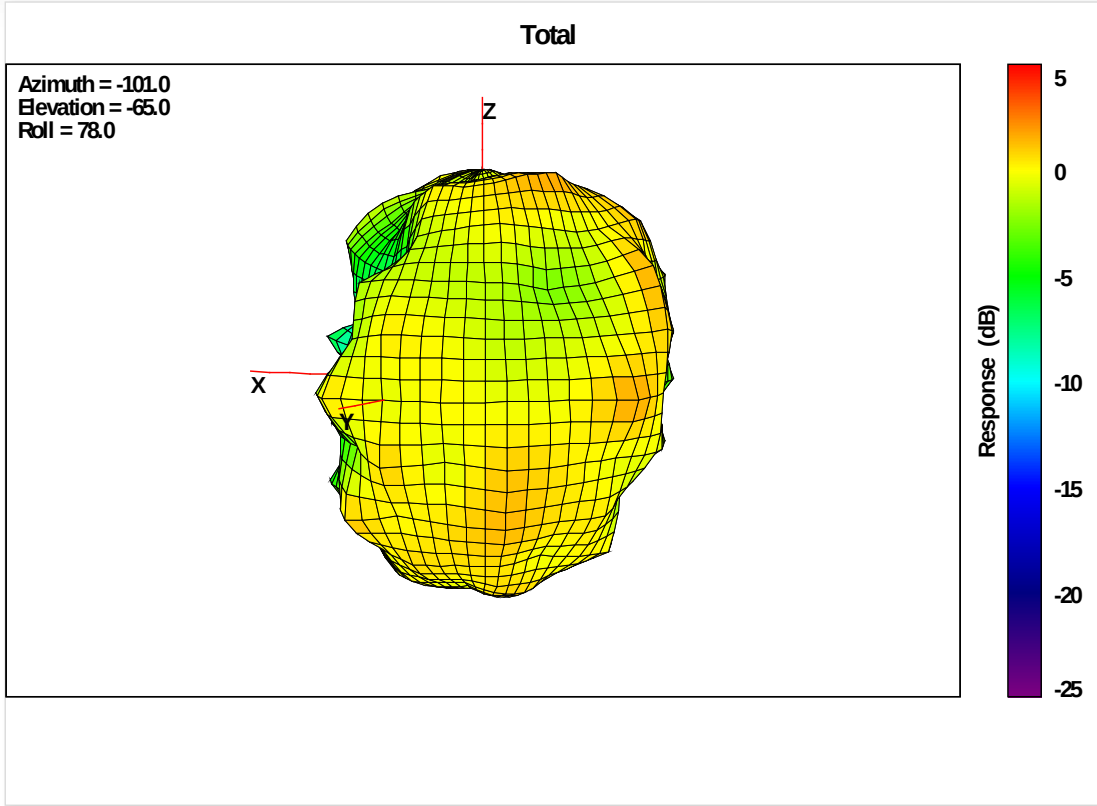


Front to Back (YZ)



Individual Antenna 3D Pattern

Total Gain 3D Pattern: Ant1_5G: Frequency = 5500MHz Peak Gain = 3.2 dBi

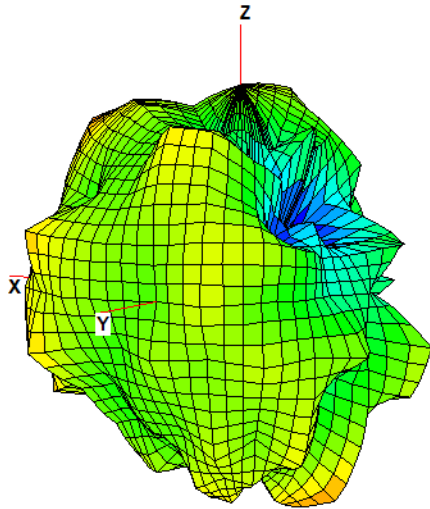


Total Gain 3D Pattern: Ant2_5G: Frequency = 5500MHz Peak Gain = 3.3 dBi



Total

Azimuth = -101.0
Elevation = -65.0
Roll = 78.0



Response (dB)

4
2
0
-2
-4
-6
-8
-10
-12
-14
-16

- Return Loss :
5G Antennas < -10dB
- Isolation:
5GHz isolation >30dB
- Peak Gain :
<4dBi
- Efficiency:
5GHz average efficiency >55%