



Part 15 Antenna Gain Report
Model 2145

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1. Antenna Gains Summary

The purpose of this report is to explain how the antenna gains for the unlicensed transmitters of the given device were measured and evaluated.

The device has two antennas which are used for WLAN / Bluetooth Tx and Rx.

- The peak gains of each antenna were measured separately. These peak gains are used in any SISO evaluations in the unlicensed test reports.
- Additionally, the directional MIMO gains of the two-antenna system were evaluated as allowed by **KDB 662911 D03 MIMO Antenna Gain Measurement v01** and confirmed through Inquiry. The following directional MIMO gains were determined:
 - Uncorrelated Directional MIMO Gains. These gains are used in the unlicensed test reports for power measurements of all WLAN modes and power spectral density (PSD) measurements of WLAN operating modes with uncorrelated signals, as per ANSI C63.10.
 - Correlated Directional MIMO Gains. These gains are used in unlicensed test reports for PSD measurements of WLAN operating modes with correlated signals, such as cyclic delay diversity (CDD.)

The summary of the Peak Gains and Directional MIMO Gains is given below.

Band	Frequency (MHz)	Left Antenna Peak Gain (Chain 1) (dBi)	Right Antenna Peak Gain (Chain 0) (dBi)	Correlated Directional MIMO Gain (dBi)	Uncorrelated Directional MIMO Gain (dBi)
2.4GHz	2400-2483.5	4.12	3.38	5.67	2.75
UNII-1	5150-5250	5.48	6.07	8.61	5.60
UNII-2A	5250-5350	6.45	5.62	8.14	5.21
UNII-2C	5470-5725	7.44	6.29	9.62	6.64
UNII-3	5725-5850	7.58	6.71	9.92	6.94
UNII-4	5850-5895	6.72	6.68	9.53	6.52
UNII-5	5925-6425	7.11	8.11	9.88	6.88
UNII-6	6425-6525	5.08	7.40	7.82	5.16
UNII-7	6525-6875	8.02	7.72	9.73	6.80
UNII-8	6875-7125	8.02	7.81	10.71	7.70

2. Test Method and Test Setup

- Measurement Facility: Microsoft Antenna Lab
- Dates of Testing: 03/27/2026 to 03/31/2026
- Test Engineer: Roshanak Zabihi
- Equipment: MVG Starlab (formerly known as Satimo)
- Calibration Verification: A reference calibration dipole was measured before the device was tested and compared to the reported values of the manufacturer to verify that the chamber calibration is within measurement uncertainty and in good standing.

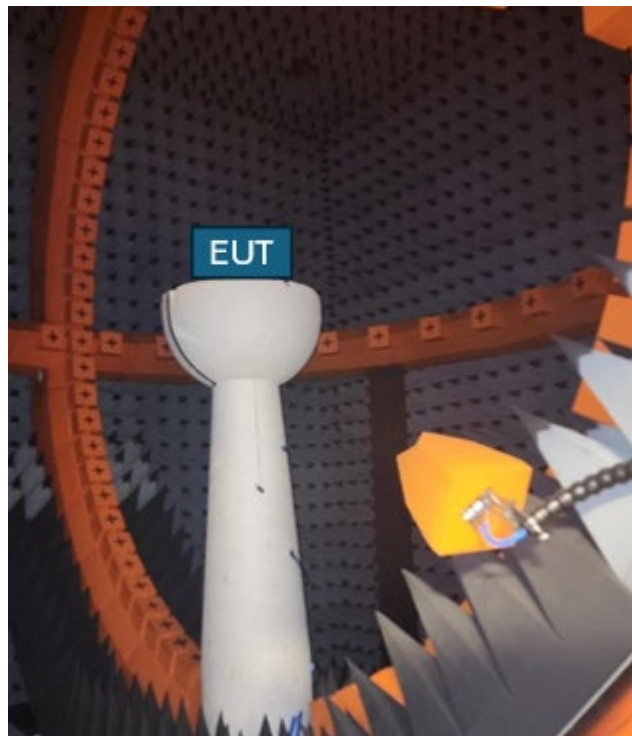
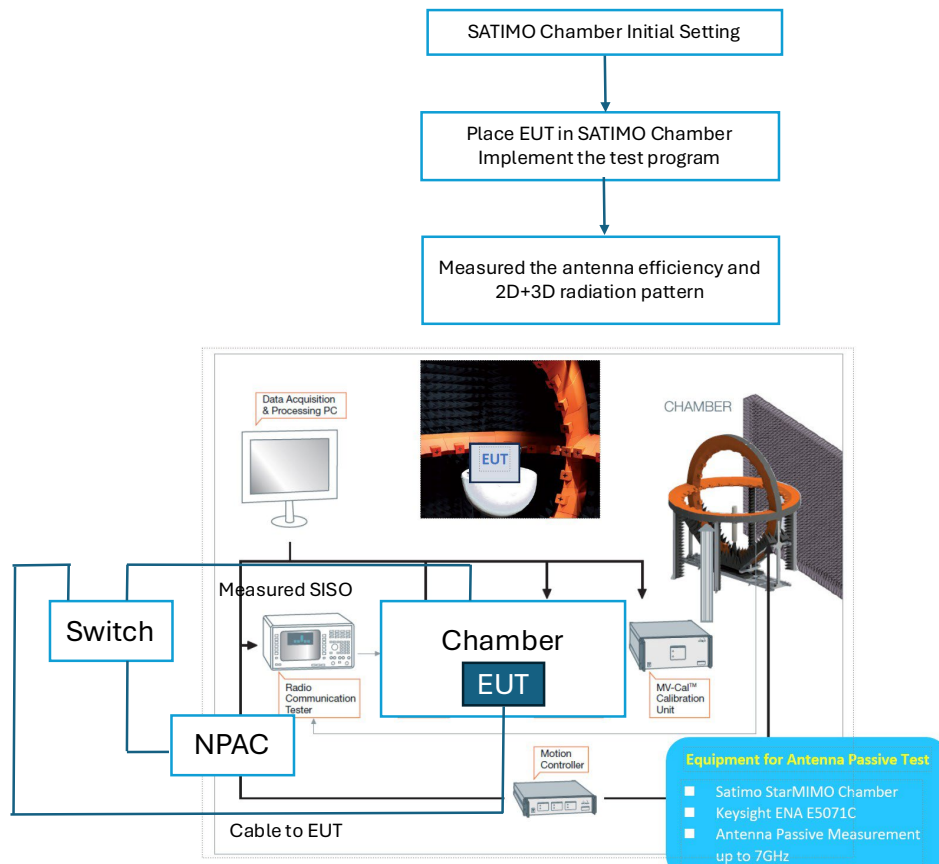
Item	Equipment	Manufacturer	Model	Calibration Date
1	SATIMO chamber	MVG	StarGate	02/17/2026
2	NPAC (New Probe Array Controller)	MVG	N/A	02/17/2026
3	Network Analyzer	Keysight	PNA-L N5232A	Next due: 03/2027
4	Validation Dipole	MVG	WD3000	N/A
5	Validation Dipole	MVG	WD6000	N/A

i. Passive Gain Calibration and Test Method

The calibration of the chamber is performed using gain by substitution method. A reference calibration dipole with known antenna gain and efficiency connected in the middle of the chamber in the quiet zone is measured and a calibration file that includes offset values for each frequency to adjust the losses of the system is generated. The device under test was tested the same way as the calibration dipoles and the calibration file described above is used to calculate the gain of each embedded antenna.

ii. Radiation Pattern and Gain Measurement

The radiation pattern and gain measurements were done in the MVG Starlab fully anechoic chamber. The antenna gain reported is the maximum measured in both horizontal and vertical polarizations. The measurement step size in both the Phi (ϕ) and Theta (θ) measurement axes was 3 degrees, meeting the requirements to use Directional MIMO Gains evaluation method.



3. Antenna Manufacturer

Antenna manufacturer 1	Shanghai Amphenol Airwave Communication Electronics Co., Ltd
Antenna Part number	Main: 1415-0BHW0QS Aux: 1415-0BHW0QS
Antenna type	PIFA

Antenna manufacturer 2	ADVANCED WIRELESS & ANTENNA INC. (AWAN)
Antenna Part number	Main: 1415-0BHX0QS Aux: 1415-0BHX0QS
Antenna type	PIFA

i. Peak Gain Details

2145 Peak Gains	Frequency (MHz)	Left Antenna Peak Gain (Chain 1)			Right Antenna Peak Gain (Chain 0)		
		Peak Gain (dBi)	Phi (°)	Theta (°)	Peak Gain (dBi)	Phi (°)	Theta (°)
2.4GHz	2400-2483.5	4.12	114	-63	3.38	39	-54
UNII-1	5150-5250	5.48	165	-15	6.07	162	-9
UNII-2A	5250-5350	6.45	159	-18	5.62	3	6
UNII-2C	5470-5725	7.44	3	15	6.29	174	-18
UNII-3	5725-5850	7.58	177	-15	6.71	168	-21
UNII-4	5850-5895	6.72	162	-21	6.68	171	-21
UNII-5	5925-6425	7.11	3	24	8.11	42	-3
UNII-6	6425-6525	5.08	165	21	7.40	6	36
UNII-7	6525-6875	8.02	12	-24	7.72	6	33
UNII-8	6875-7125	8.02	168	24	7.81	168	21

ii. Directional MIMO Gain Details

The Directional MIMO Gains were determined computationally from the standalone antenna gains. For each point in space, the Directional MIMO Gains were calculated by performing both the Uncorrelated and Correlated Gain calculations on the gain values from each antenna at that point in space. The highest results calculation results in each band are used as the Directional gains. Note that in some cases the highest uncorrelated and correlated values occur at different points in space.

These are the directional Gain equations used from KDB 662911 D01 (Section F.2.d), for this case where number of antennas N=2:

$$\text{Uncorrelated Gain} = 10 * \log \frac{10^{\frac{G1}{10}} + 10^{\frac{G2}{10}} + \dots + 10^{\frac{GN}{10}}}{N \text{ ANT}} \text{ dBi}$$

$$\text{Correlated Gain} = 10 * \log \frac{(10^{\frac{G1}{20}} + 10^{\frac{G2}{20}} + \dots + 10^{\frac{GN}{20}})^2}{N \text{ ANT}} \text{ dBi}$$

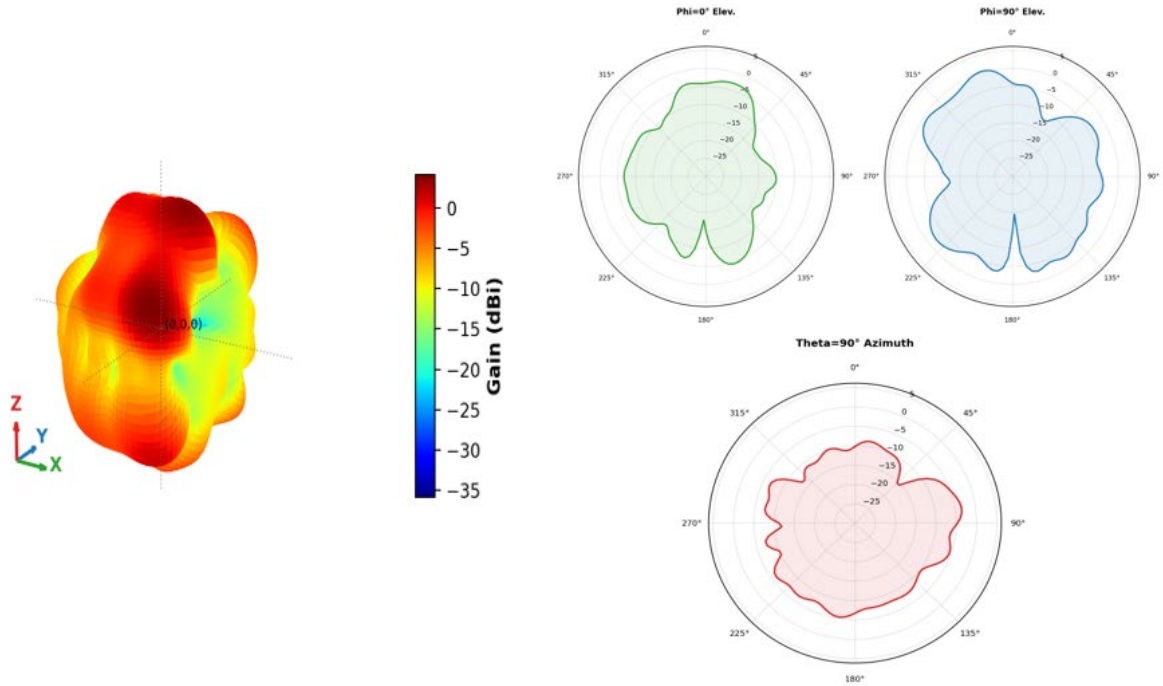
These equations were applied at all measurement points for the two antennas, at all frequencies. The highest Uncorrelated and Correlated Directional MIMO Gains values with their locations in space are as follows:

Freq. Band	Freq. (MHz)	Uncorrelated Directional MIMO Gain					Correlated Directional MIMO Gain				
		Uncorr. Gain (dBi)	φ (°)	θ (°)	Left Gain (dBi)	Right Gain (dBi)	Corr. Gain (dBi)	φ (°)	θ (°)	Left Gain (dBi)	Right Gain (dBi)
2.4GHz	2400-2483.5	2.75	111	-60	3.86	1.24	5.67	111	-60	3.53	1.70
UNII-1	5150-5250	5.60	165	-12	5.42	5.78	8.61	165	-12	5.42	5.78
UNII-2A	5250-5350	5.21	159	-18	6.45	3.46	8.14	165	-12	5.29	4.97
UNII-2C	5470-5725	6.64	0	15	7.30	5.87	9.62	0	15	7.30	5.87
UNII-3	5725-5850	6.94	177	-15	7.58	6.18	9.92	177	-15	7.58	6.18
UNII-4	5850-5895	6.52	162	-21	6.49	6.55	9.53	162	-21	6.49	6.55
UNII-5	5925-6425	6.88	171	-21	6.59	7.14	9.88	171	-21	6.59	7.14
UNII-6	6425-6525	5.16	6	36	1.85	7.01	7.82	6	36	1.85	7.01
UNII-7	6525-6875	6.80	168	27	7.84	5.43	9.73	168	27	7.84	5.43
UNII-8	6875-7125	7.70	168	24	8.02	7.36	10.71	168	24	8.02	7.36

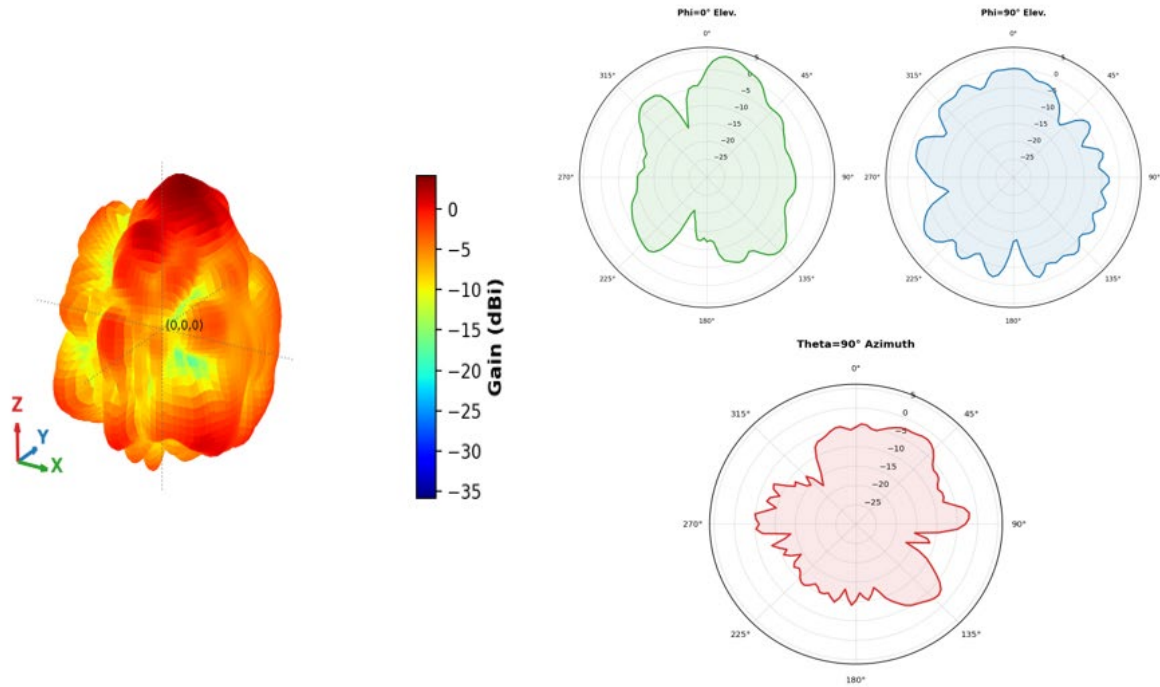
4. Radiated Characteristics of Antennas in Host Platform

A. Left Antenna (Chain 1)

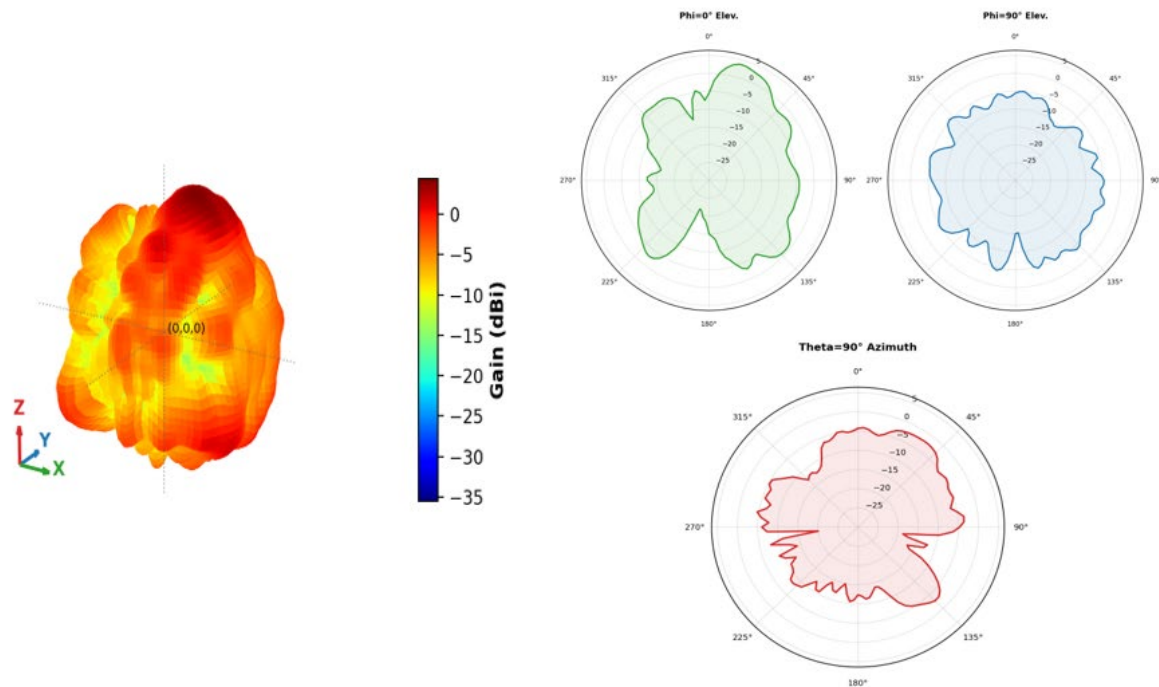
Chain 1 — 2.4GHz 2400-2483.5 MHz | Peak Gain: 4.12 dBi



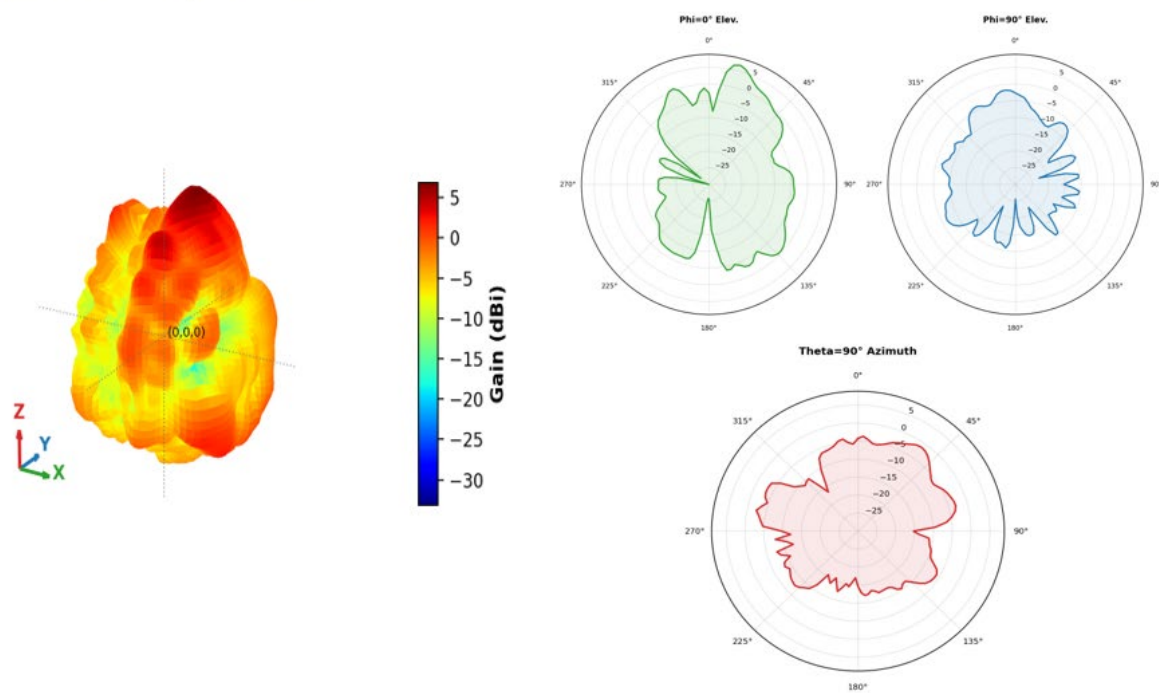
Chain 1 — UNII-1 5150-5250 MHz | Peak Gain: 5.48 dBi



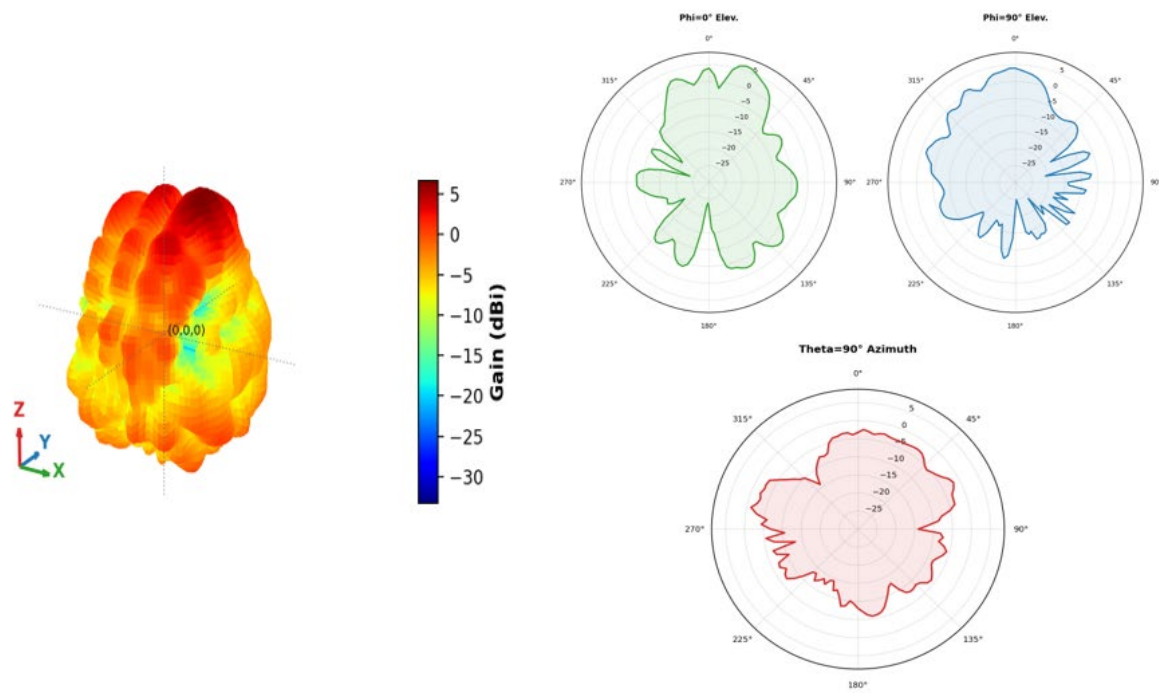
Chain 1— UNII-2A 5250-5350 MHz | Peak Gain: 6.45 dBi



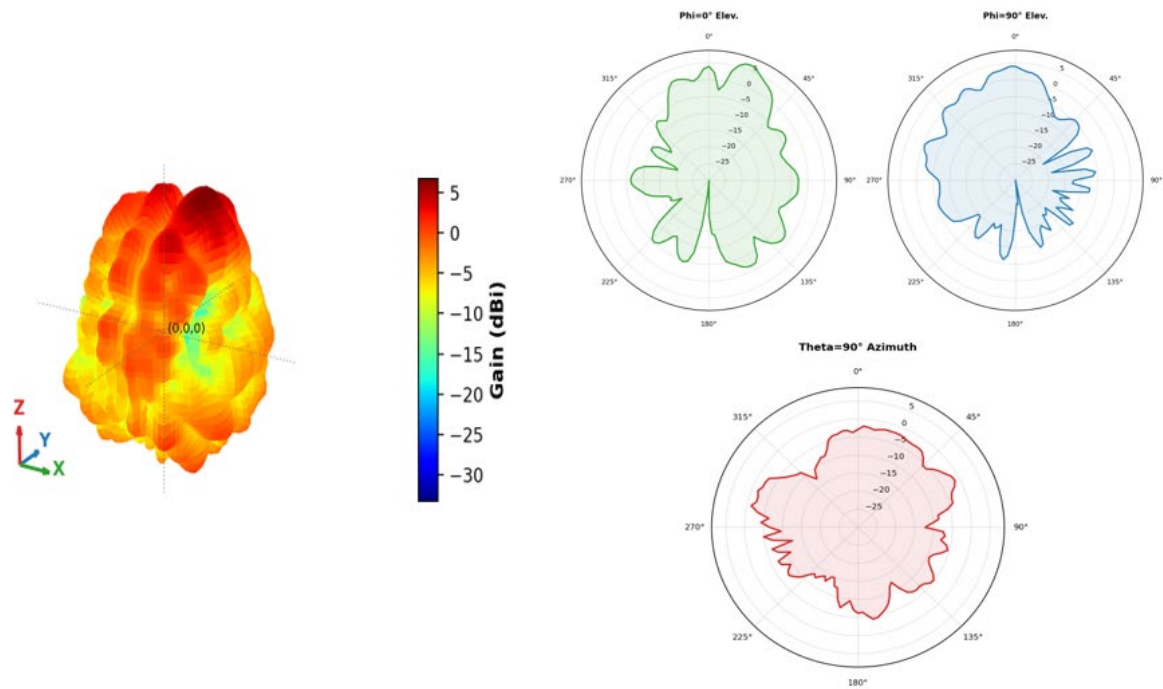
Chain 1 — UNII-2C 5470-5725 MHz | Peak Gain: 7.44 dBi



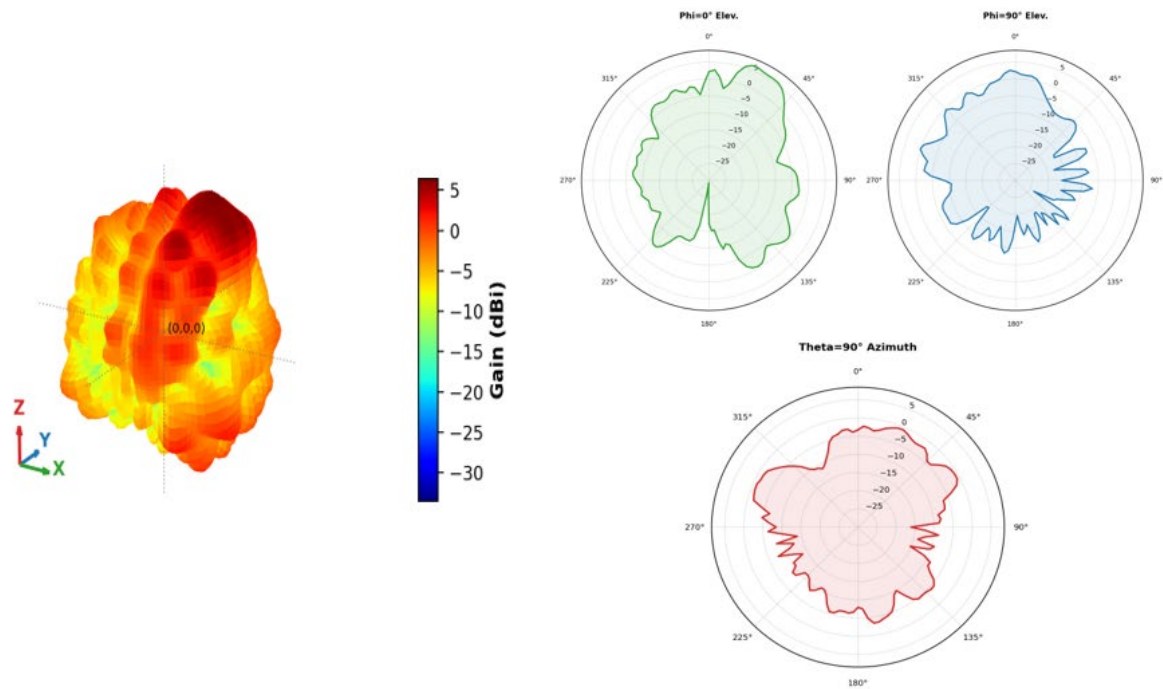
Chain 1 — UNII-3 5725-5850 MHz | Peak Gain: 7.58 dBi



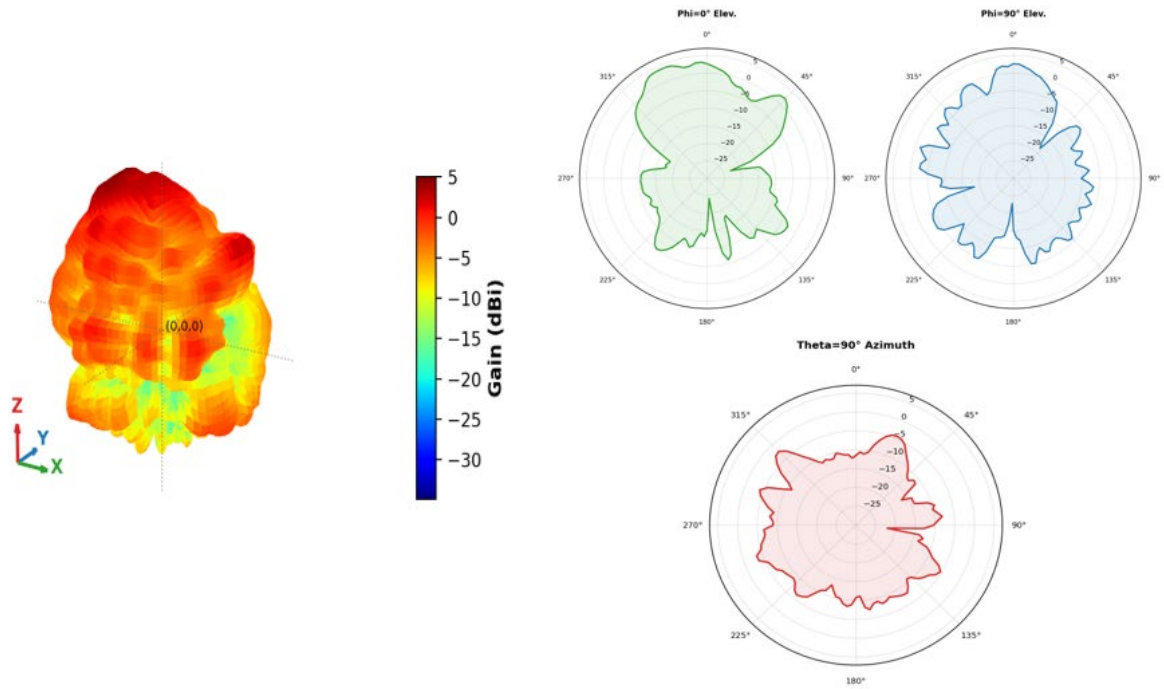
Chain 1 — UNII-4 5850-5895 MHz | Peak Gain: 6.72 dBi



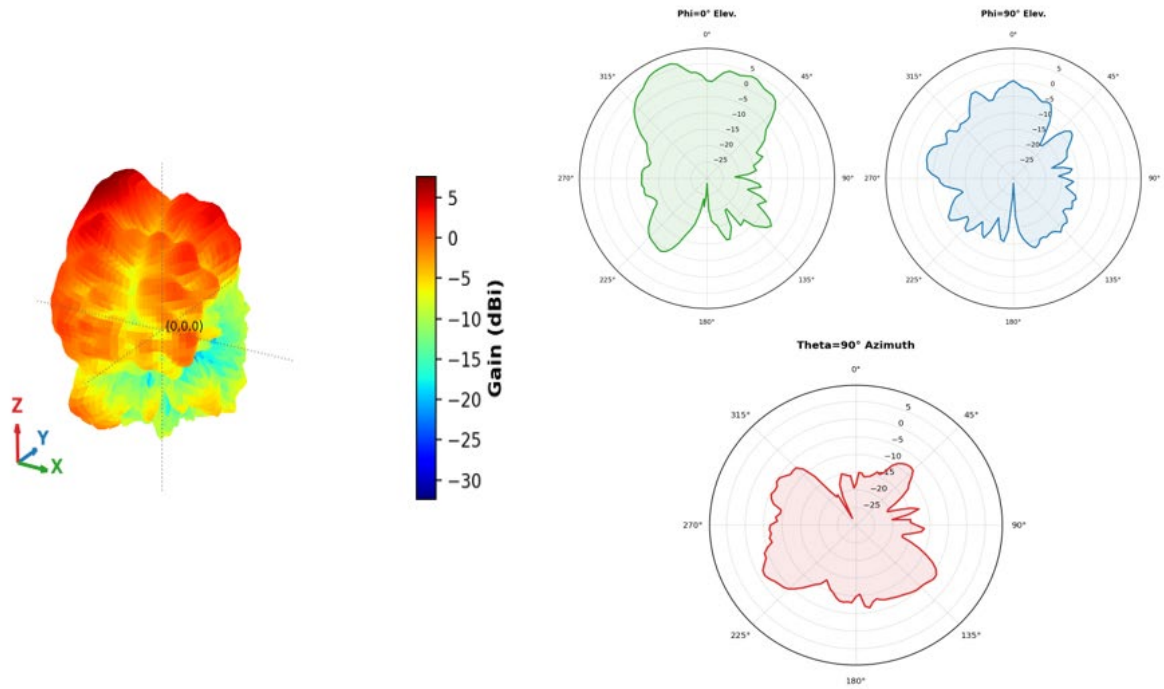
Chain 1 — UNII-5 5925-6425 MHz | Peak Gain: 7.11 dBi



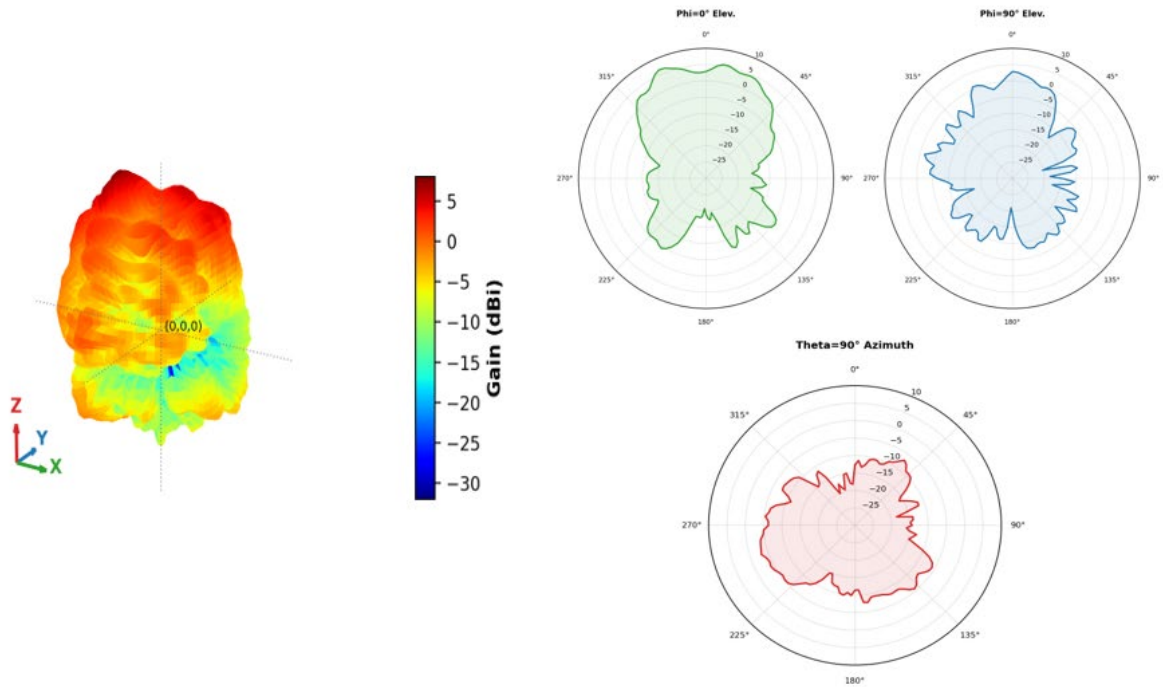
Chain 1 — UNII-6 6425-6525 MHz | Peak Gain: 5.08 dBi



Chain 1 — UNII-7 6525-6875 MHz | Peak Gain: 8.02 dBi

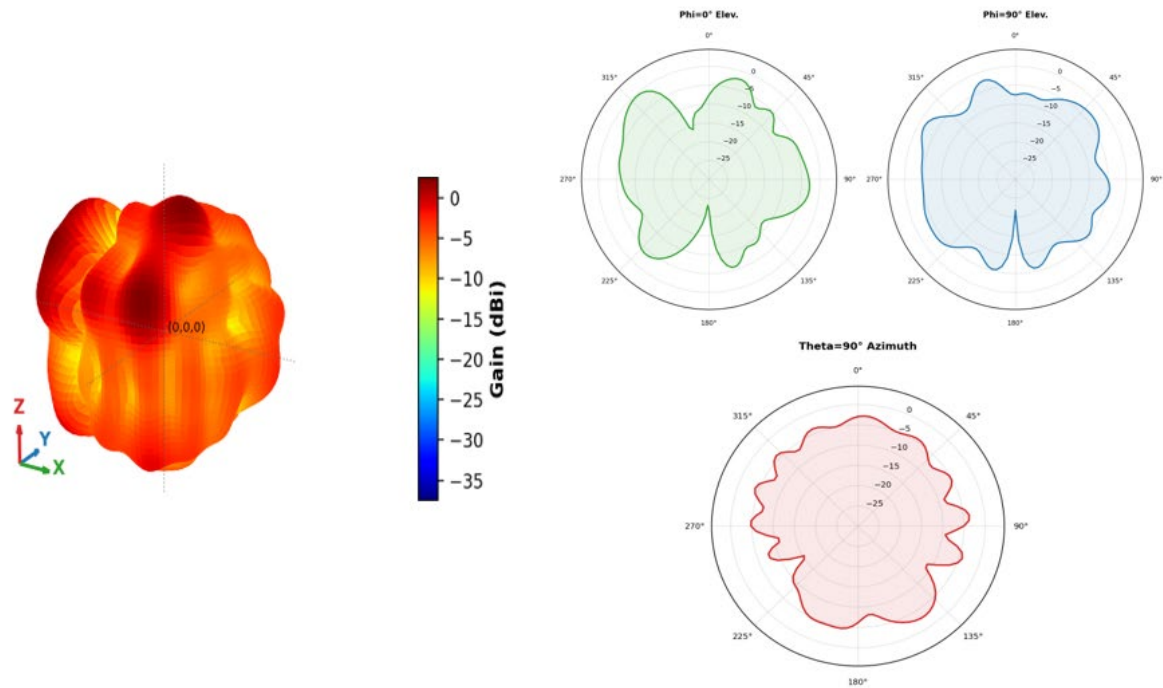


Chain 1 — UNII-8 6875-7125 MHz | Peak Gain: 8.02 dBi

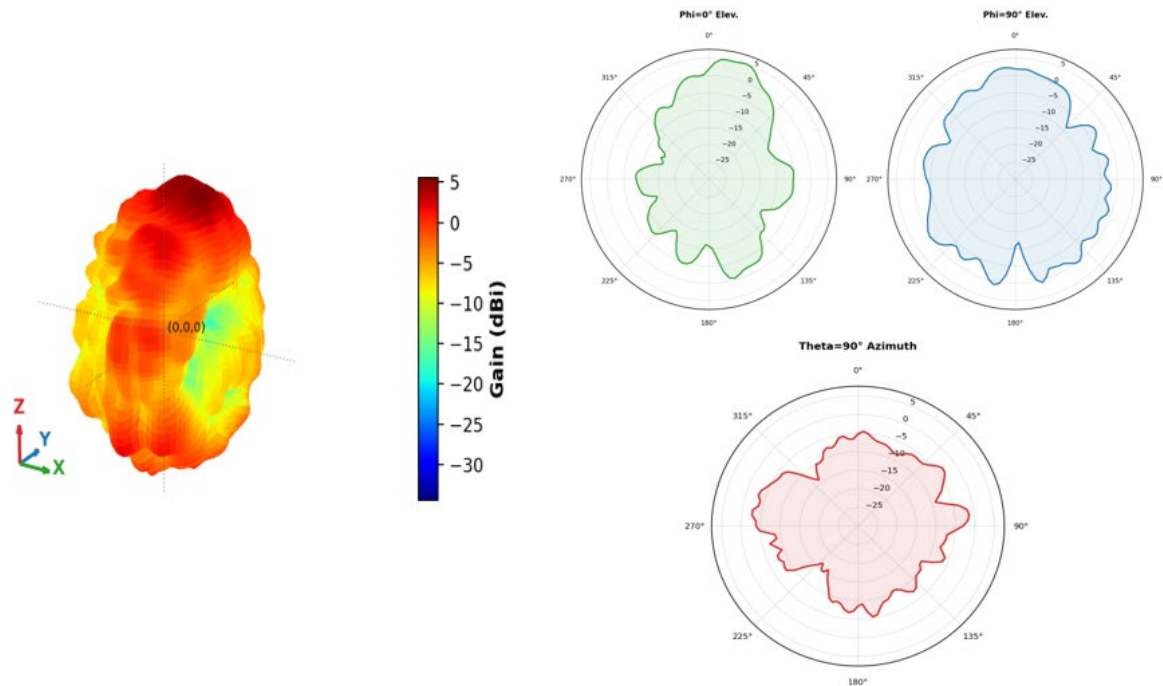


B. Right Antenna (Chain 0)

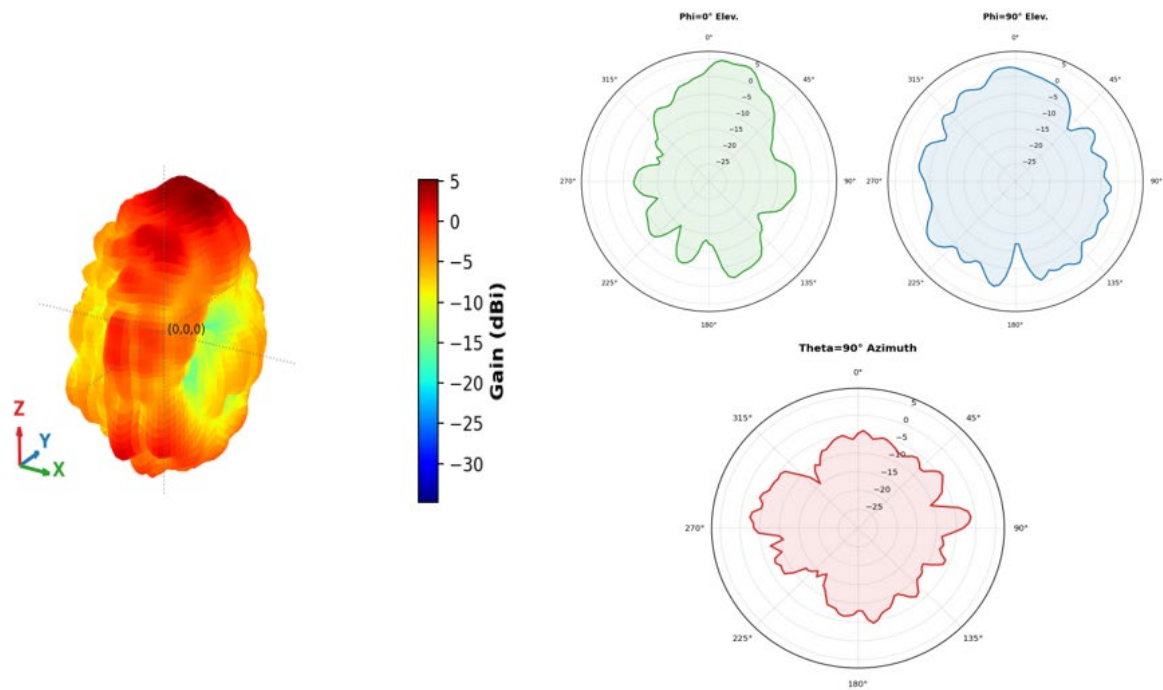
Chain 0 — 2.4GHz 2400-2483.5 MHz | Peak Gain: 3.38 dBi



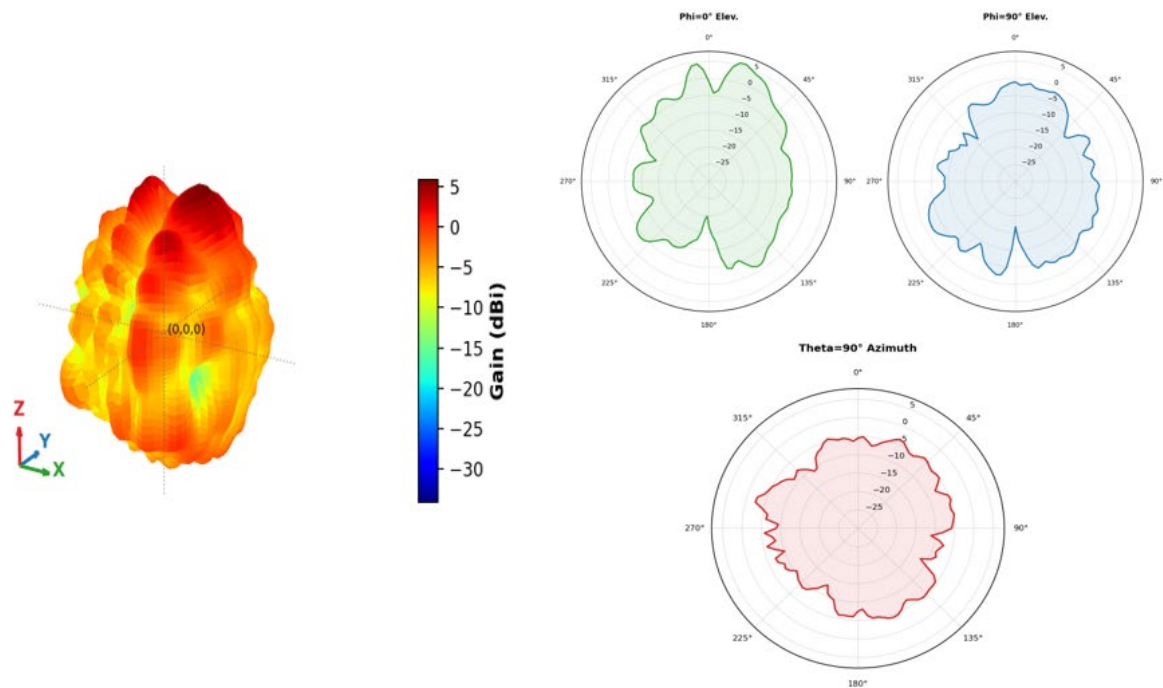
Chain 0 — UNII-1 5150-5250 MHz | Peak Gain: 6.07 dBi



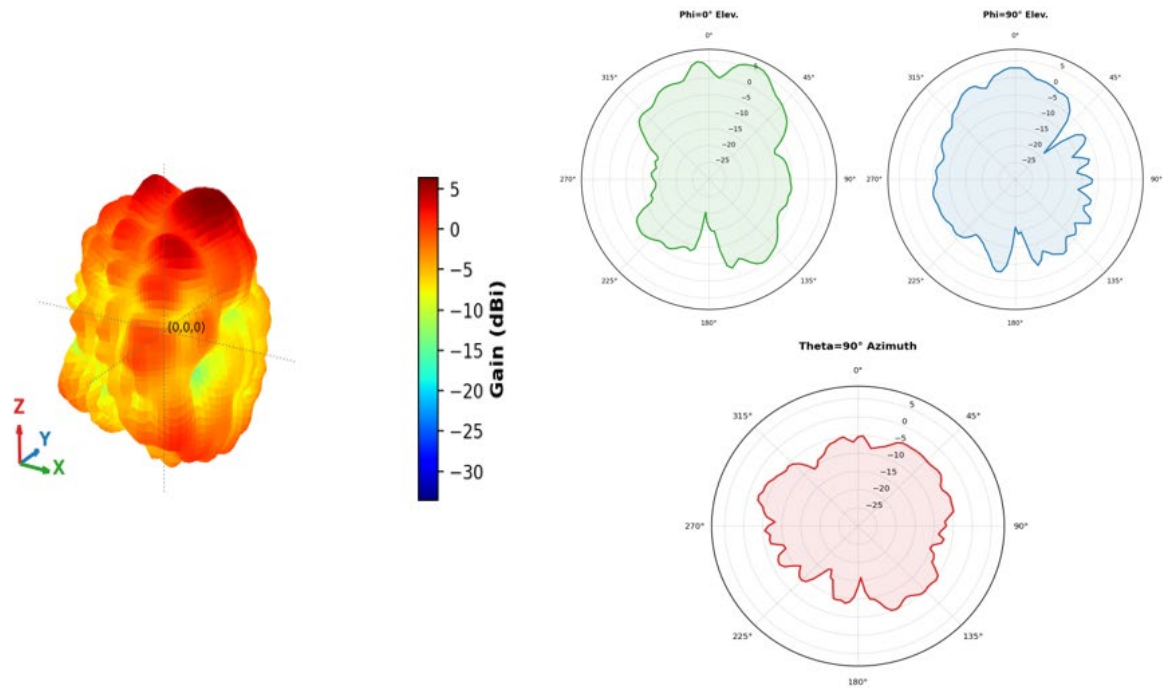
Chain 0 — UNII-2A 5250-5350 MHz | Peak Gain: 5.62 dBi



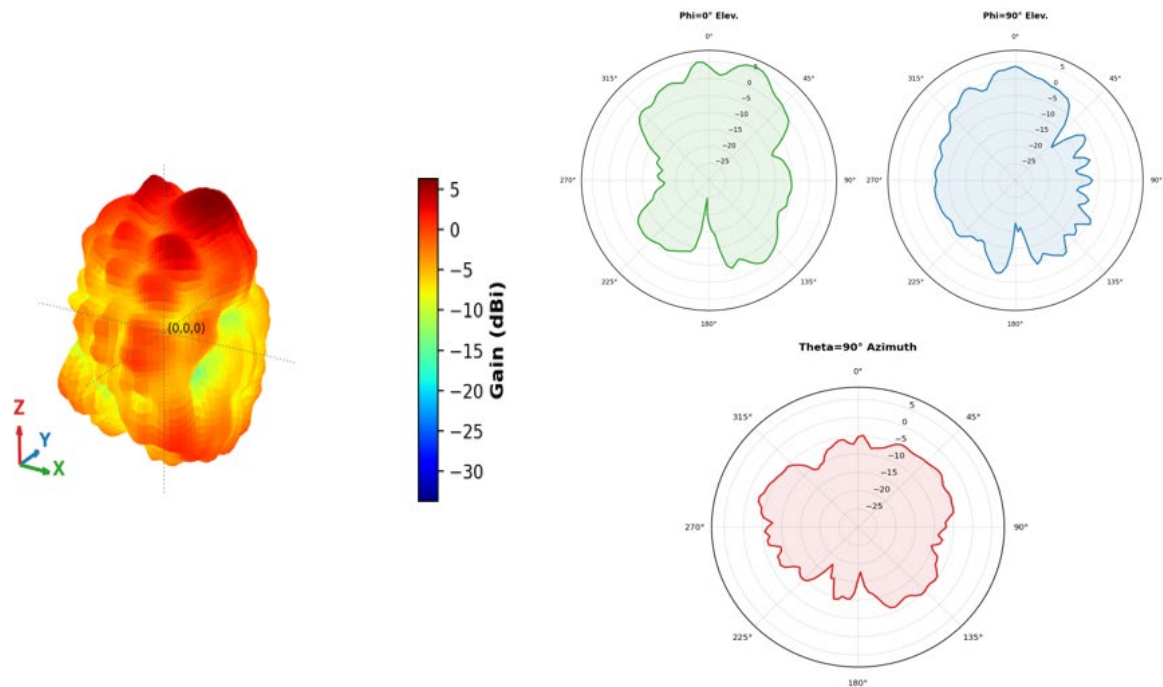
Chain 0 — UNII-2C 5470-5725 MHz | Peak Gain: 6.29 dBi



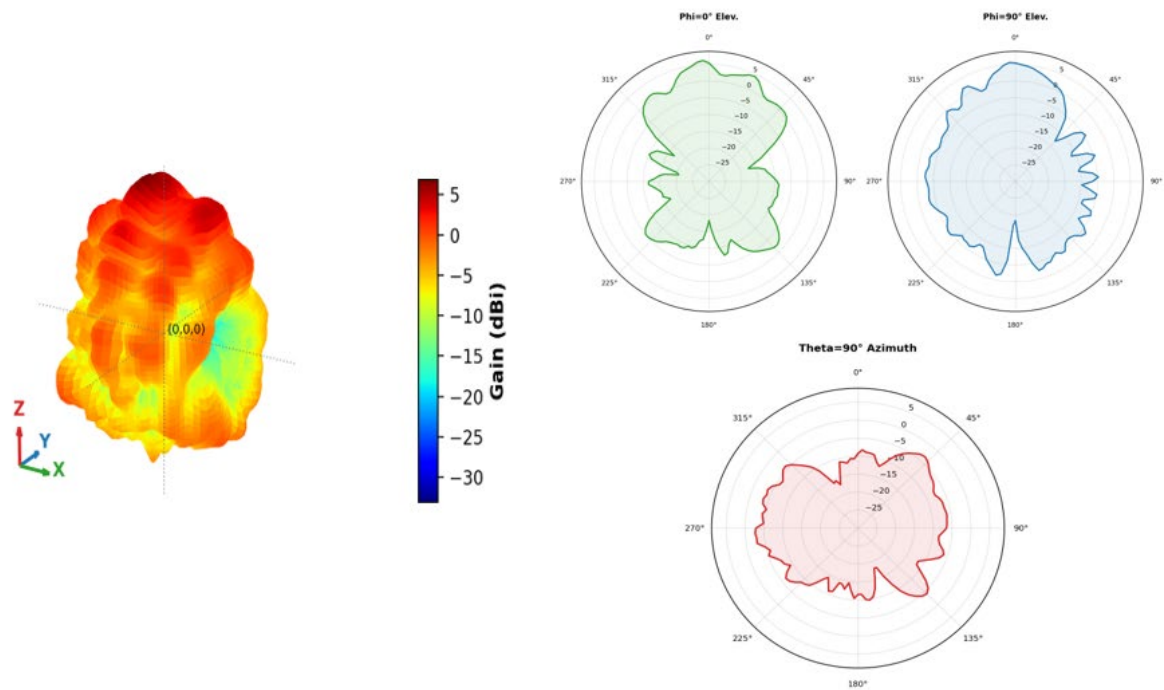
Chain 0 — UNII-3 5725-5850 MHz | Peak Gain: 6.71 dBi



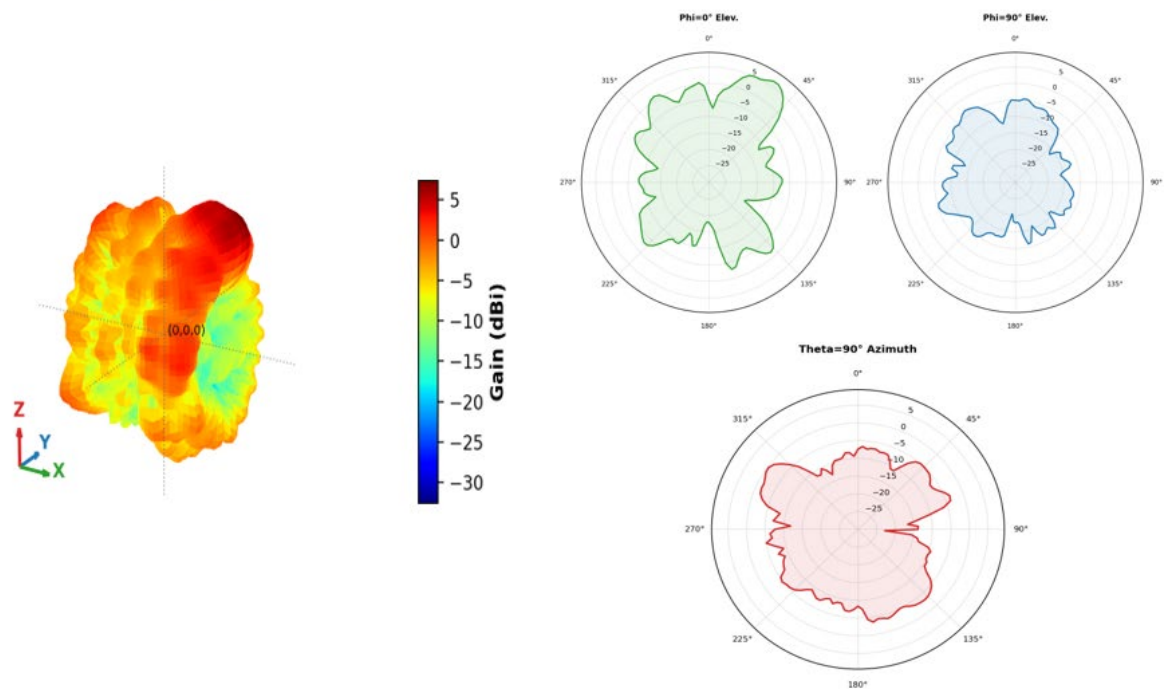
Chain 0 — UNII-4 5850-5895 MHz | Peak Gain: 6.68 dBi



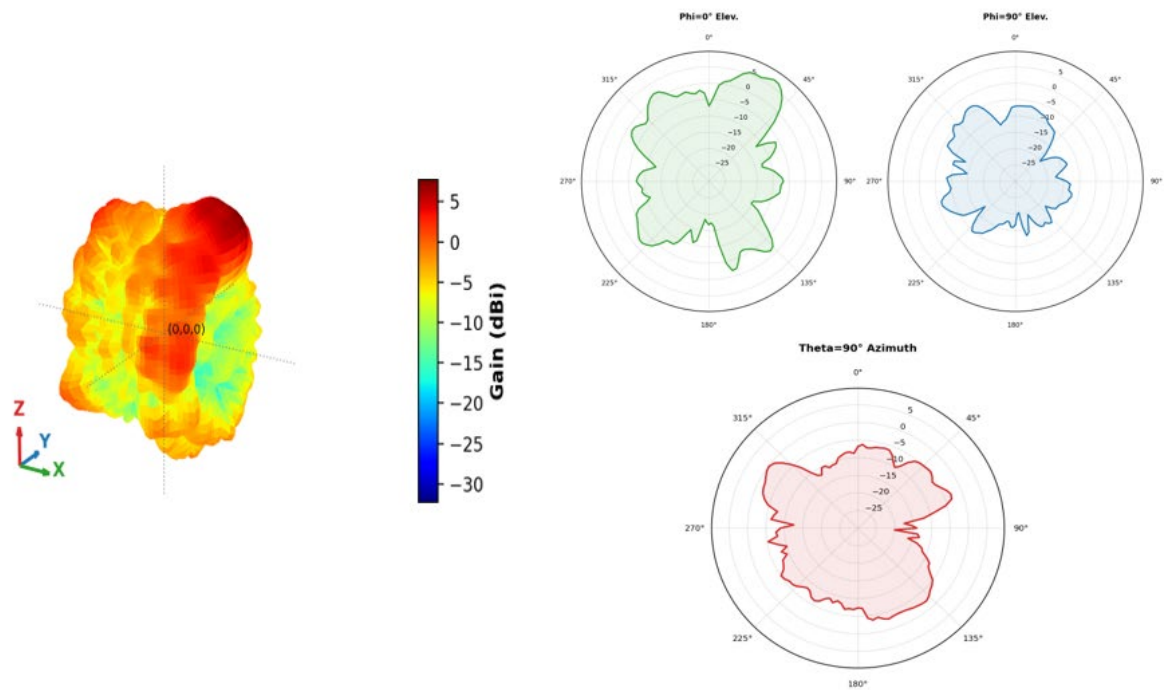
Chain 0 — UNII-5 5925-6425 MHz | Peak Gain: 8.11 dBi



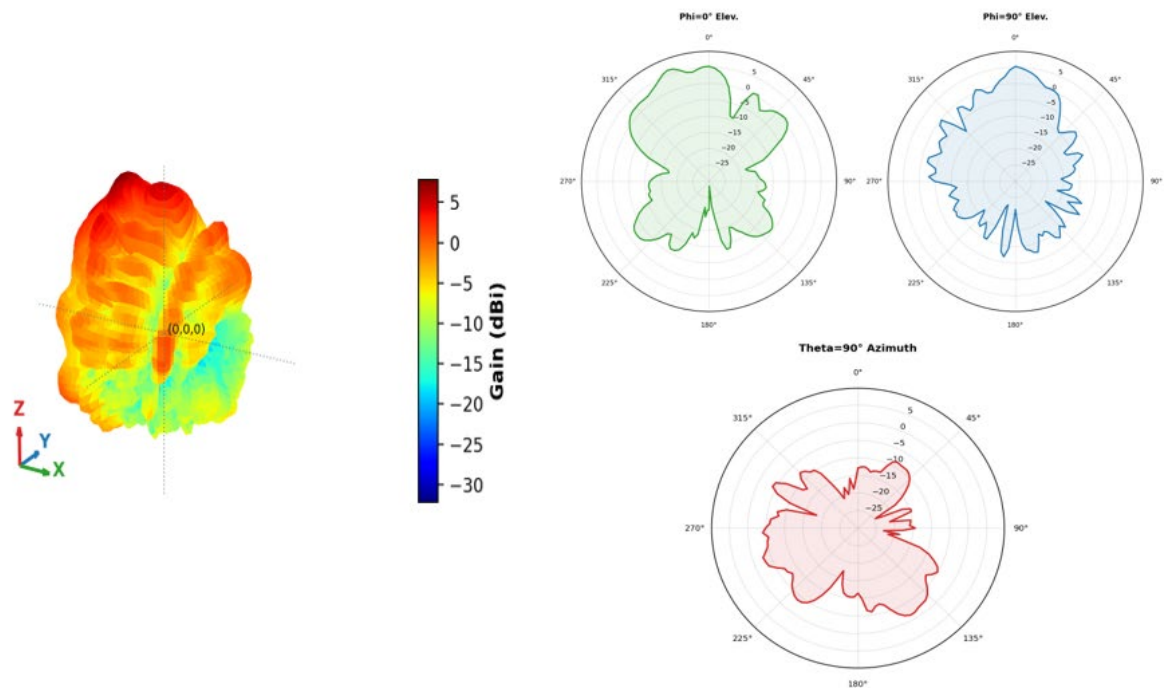
Chain 0 — UNII-6 6425-6525 MHz | Peak Gain: 7.40 dBi



Chain 0 — UNII-7 6525-6875 MHz | Peak Gain: 7.72 dBi



Chain 0 — UNII-8 6875-7125 MHz | Peak Gain: 7.81 dBi



Record of Revisions

Revision	Date	Summary of Changes
1.0	7/8/2026	First Version