

Model(s) 2148, 2149 Antenna Gain Report

Peak De-embedded Gain per Band (Gain – AFR Pigtail Loss)

Antenna Information

Category	Sub-field	Details
Antenna manufacturer	Company name Address	AWAN (ADVANCED WIRELESS & ANTENNA INC.) 5F., No.225, Sec. 3, Beixin Rd. Xindian Dist., New Taipei City, 231, Taiwan.
Antenna Part number	Main Aux	1415-OBM20QS 1415-OBM00QS
Antenna type		PIFA

Test Method and Test Setup

- Measurement Facility: Microsoft Antenna Lab
- Dates of Testing: 03/22/2026 to 03/31/2026
- Test Engineer: Chulmin Han



- 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
4	Validation Dipole	MVG	SD2450	02/18/2026
5	Validation Dipole	MVG	SD5150	02/18/2026

Test Procedure Flow:

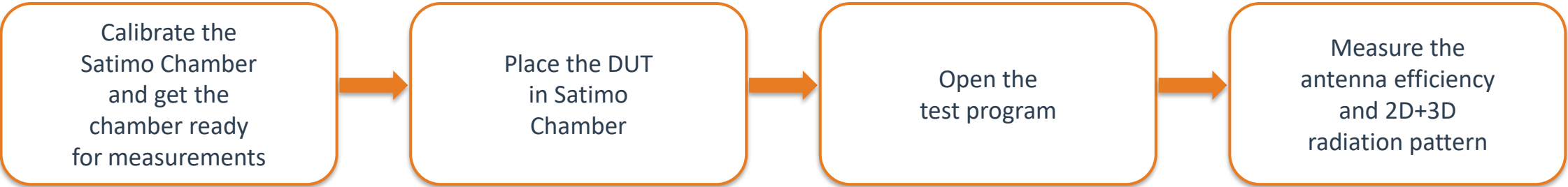


Figure 1: Test Method

Calibration and Measurement Methods

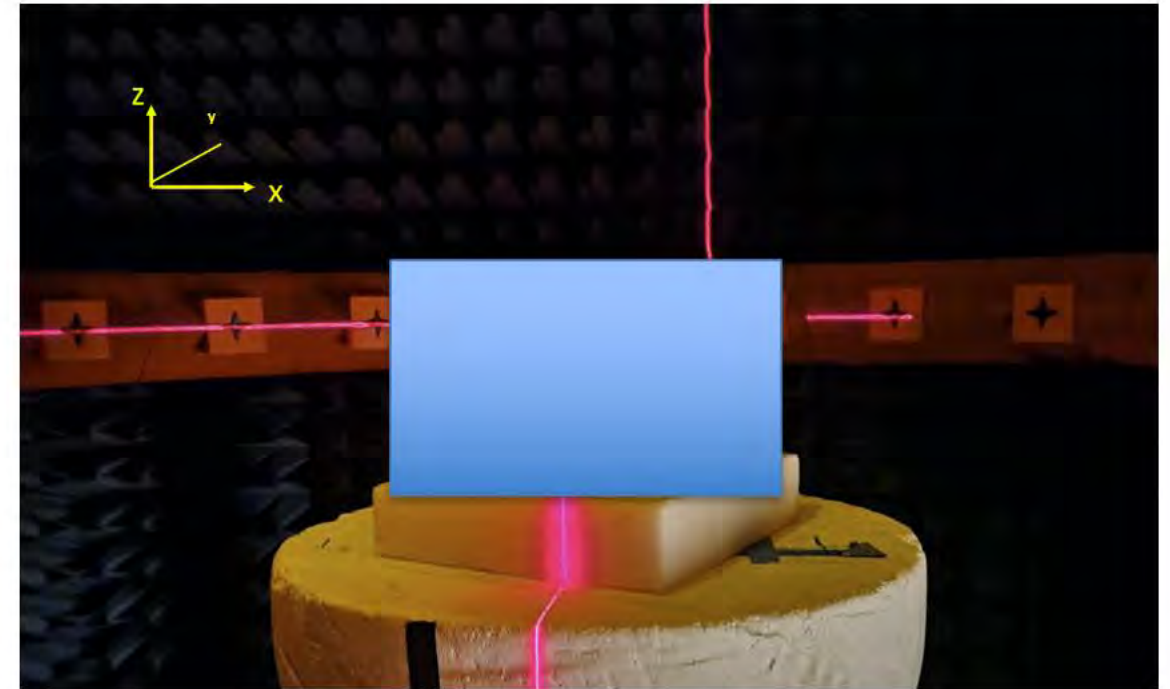
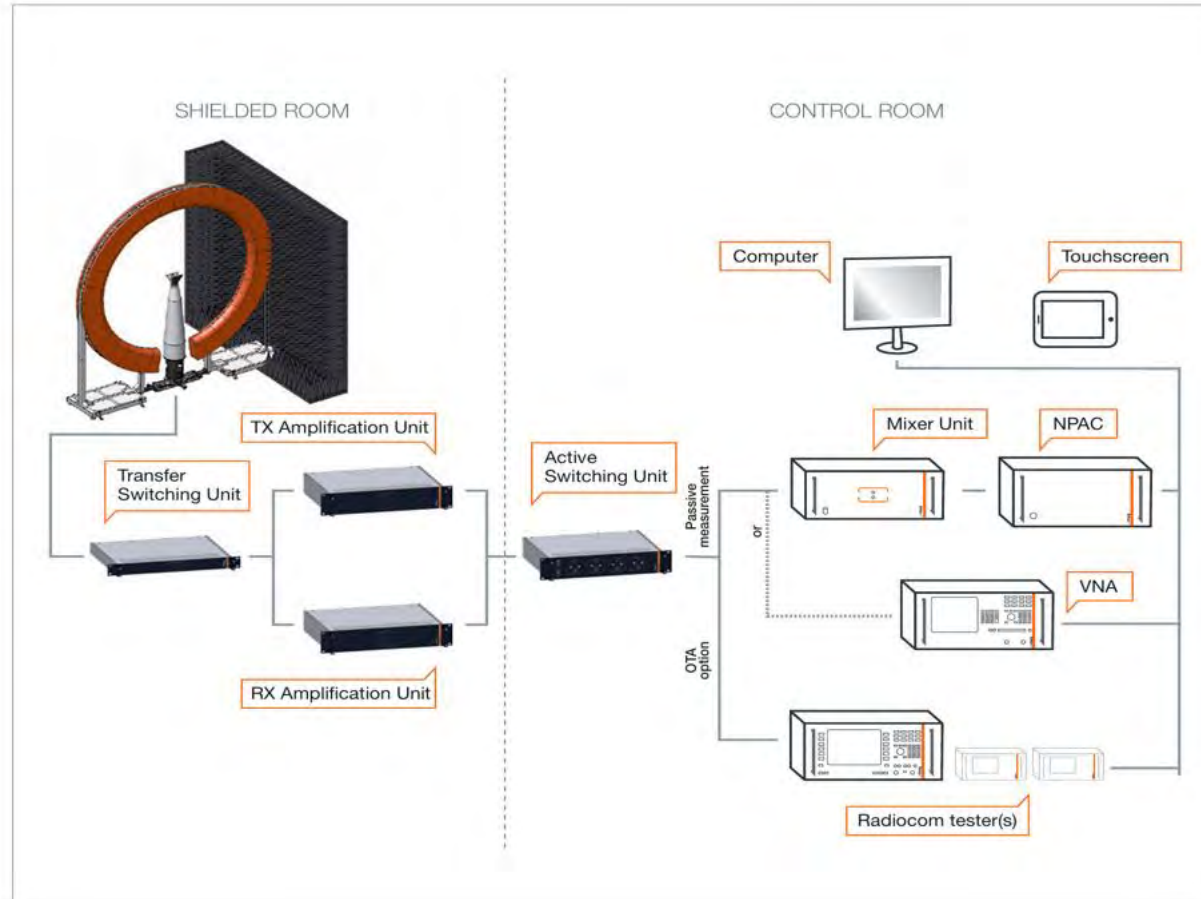
i. Passive Gain Calibration and Test Method

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.

Test Setup — MVG Starlab Chamber Diagram



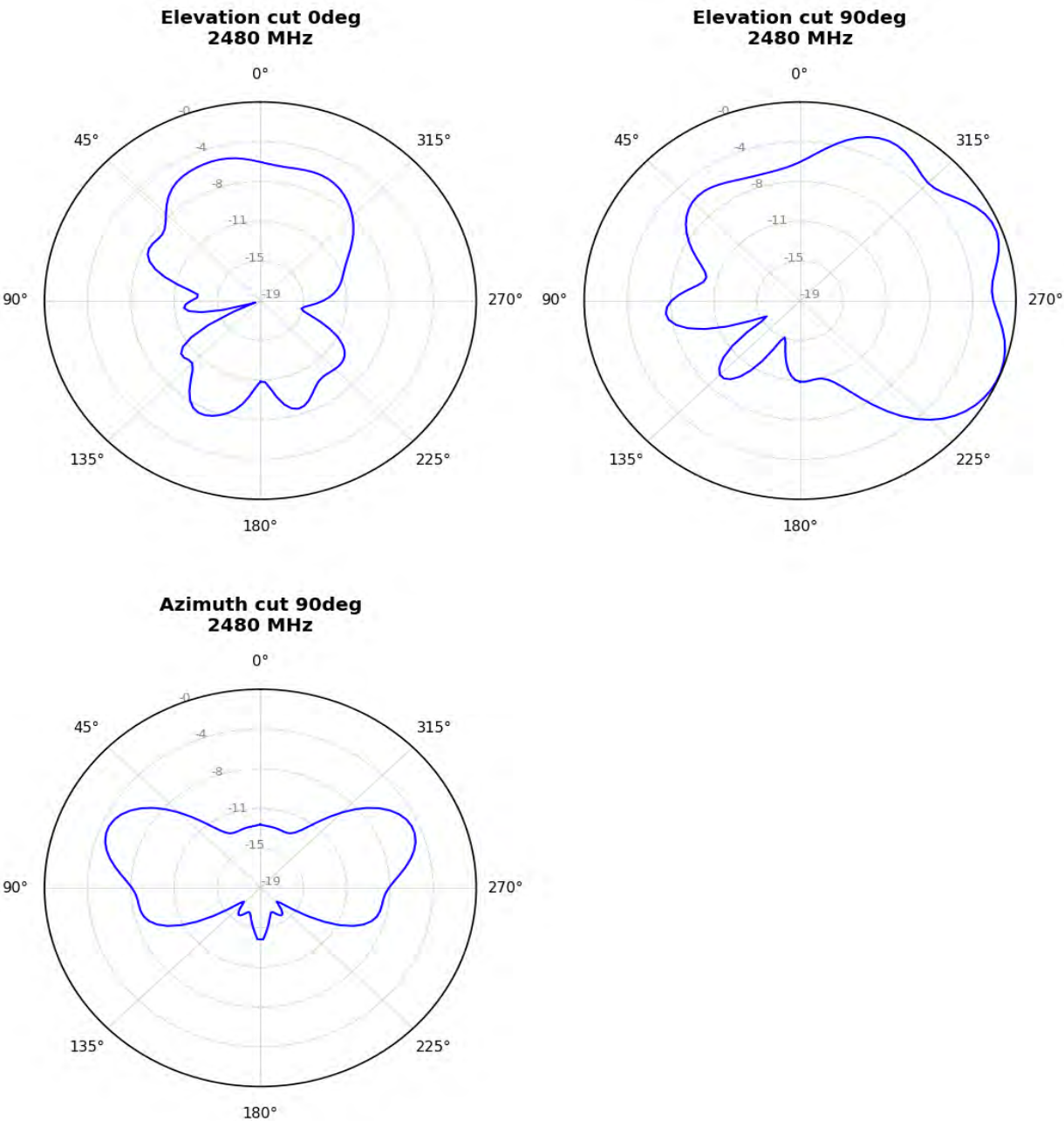
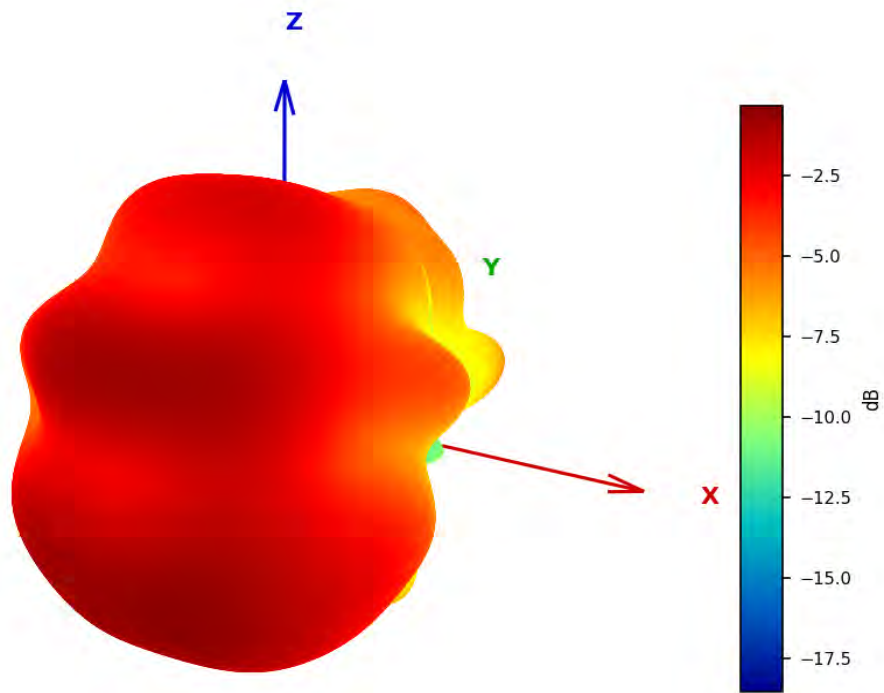
Test setup in the chamber

Antenna Peak Gain w/ Cable Loss (dBi)										
Peak gain at highest-gain frequency within each sub-band Exact Satimo measured frequency (no interpolation)										
Band	2.4GHz	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3	U-NII-4	U-NII-5	U-NII-6	U-NII-7	U-NII-8
Frequency (MHz)	2400-2483.5	5150-5250	5250-5350	5470-5725	5725-5850	5850-5895	5925-6425	6425-6525	6525-6875	6875-7125
Ant 1 (Left Antenna)										
SISO Peak Gain (dBi) (Applies to EU and US/CA Bluetooth)	0.46	3.18	3.35	3.56	3.02	2.38	3.11	3.17	3.49	2.71
Peak Freq (MHz)	2480	5200	5300	5500	5750	5850	6405	6505	6705	6905
θ°, φ°	-111°, 96°	-111°, 132°	-111°, 132°	-114°, 129°	-117°, 132°	-117°, 132°	-96°, 42°	-96°, 42°	-96°, 42°	-96°, 42°
Ant 2 (Right Antenna)										
SISO Peak Gain (dBi) (Applies to EU and US/CA Bluetooth)	-0.13	2.99	3.34	3.01	1.85	1.85	3.45	3.16	4.64	3.89
Peak Freq (MHz)	2430	5200	5300	5500	5750	5850	6255	6505	6855	6905
θ°, φ°	-111°, 87°	-108°, 45°	-108°, 45°	-108°, 114°	-111°, 114°	-81°, 81°	-96°, 135°	-99°, 141°	-108°, 39°	-108°, 42°
New MIMO Gain (dBi)										
Measured MIMO (Uncorrelated)	-0.06	2.88	3.08	3.24	2.08	1.70	3.02	3.08	4.10	3.28
Measured MIMO (Correlated)	2.95	5.88	6.09	6.25	5.03	4.68	6.03	6.09	7.09	6.27

Antenna 1

WiFi | Ant. 1 | 2.4GHz (2400-2483.5 MHz)

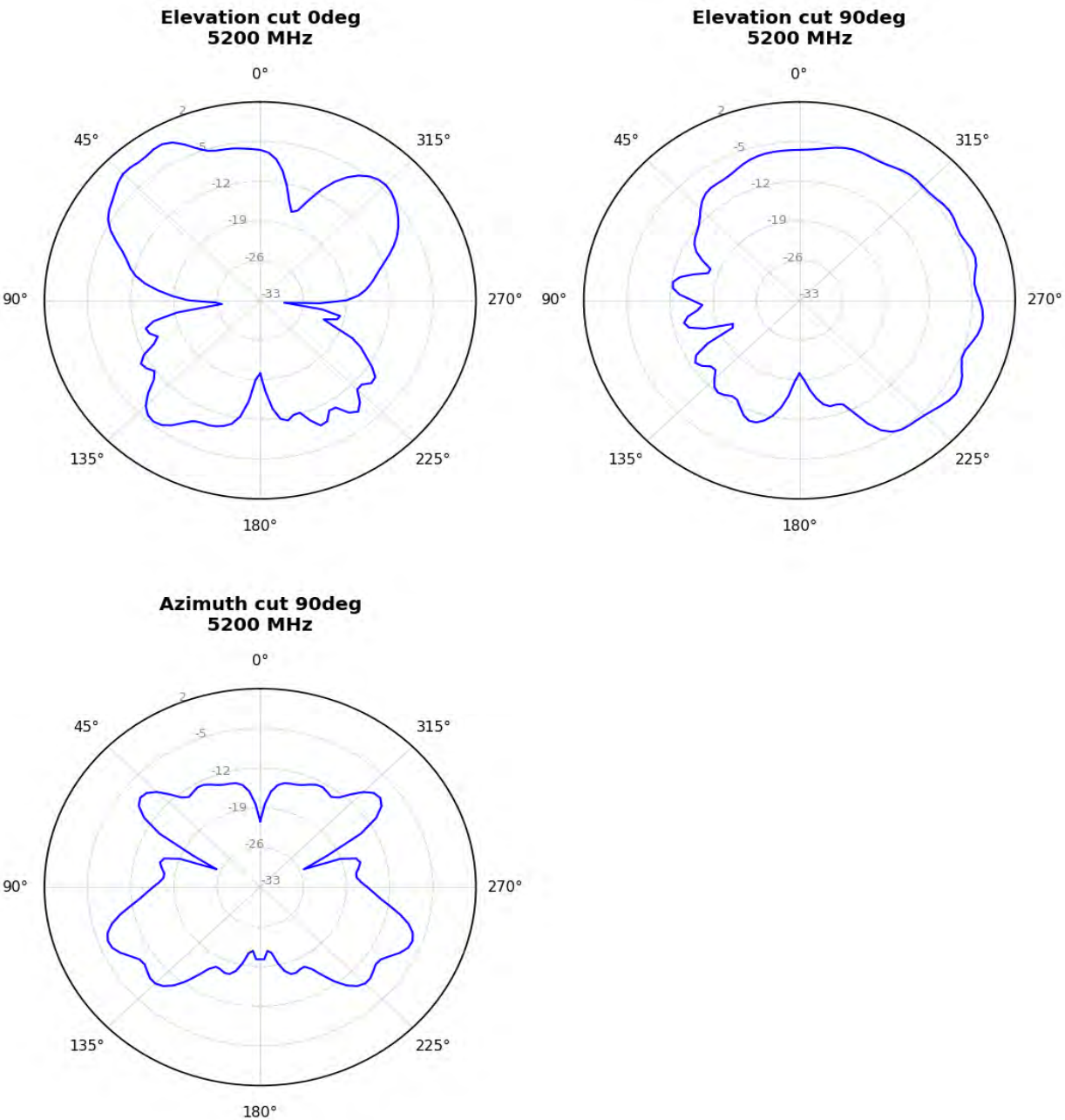
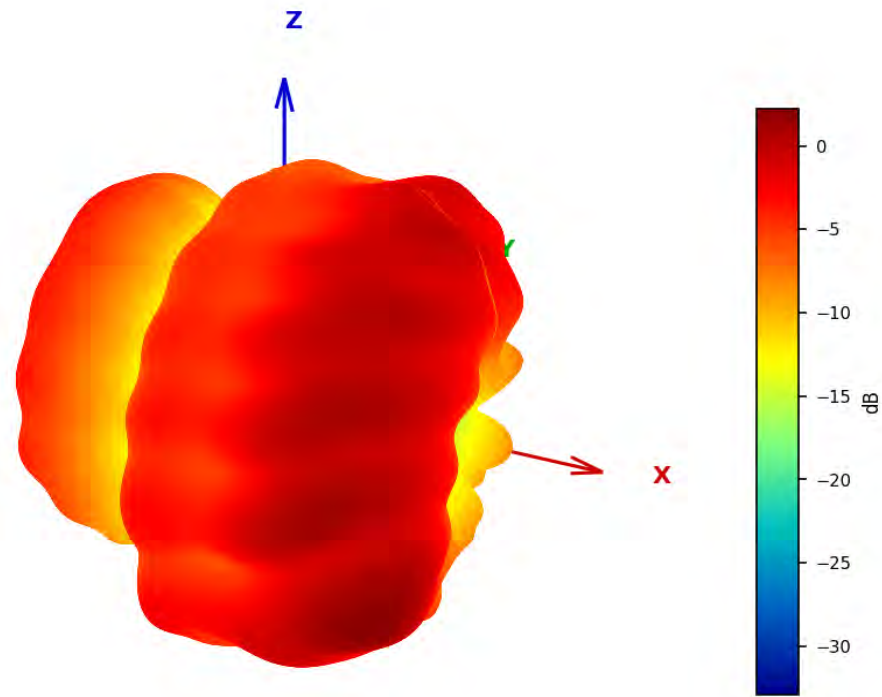
3D Radiation Pattern | 2480 MHz | Peak Gain: 0.46 dBi



3D Radiation Pattern (ETotal)

WiFi | Ant. 1 | U-NII-1 (5150-5250 MHz)

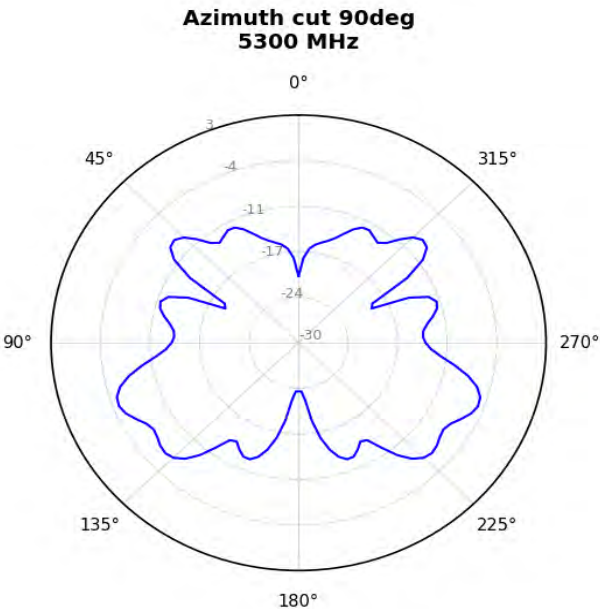
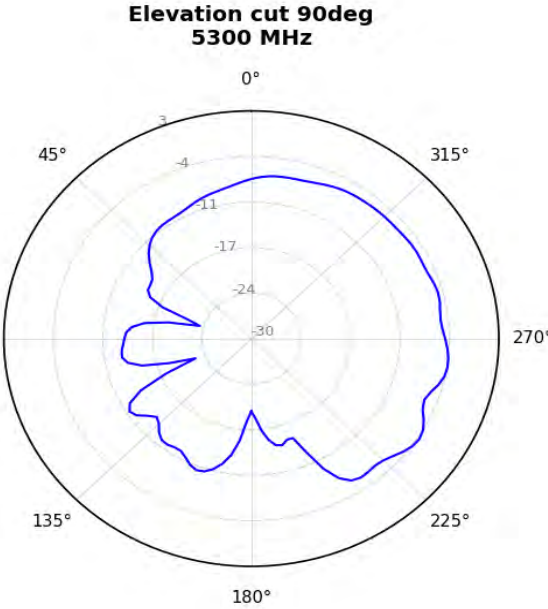
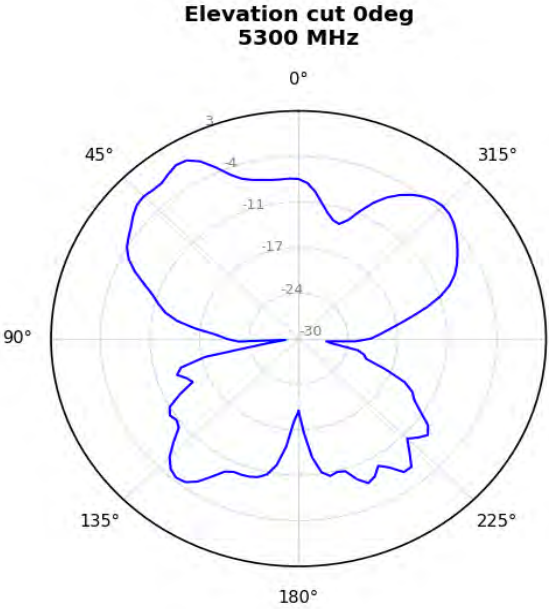
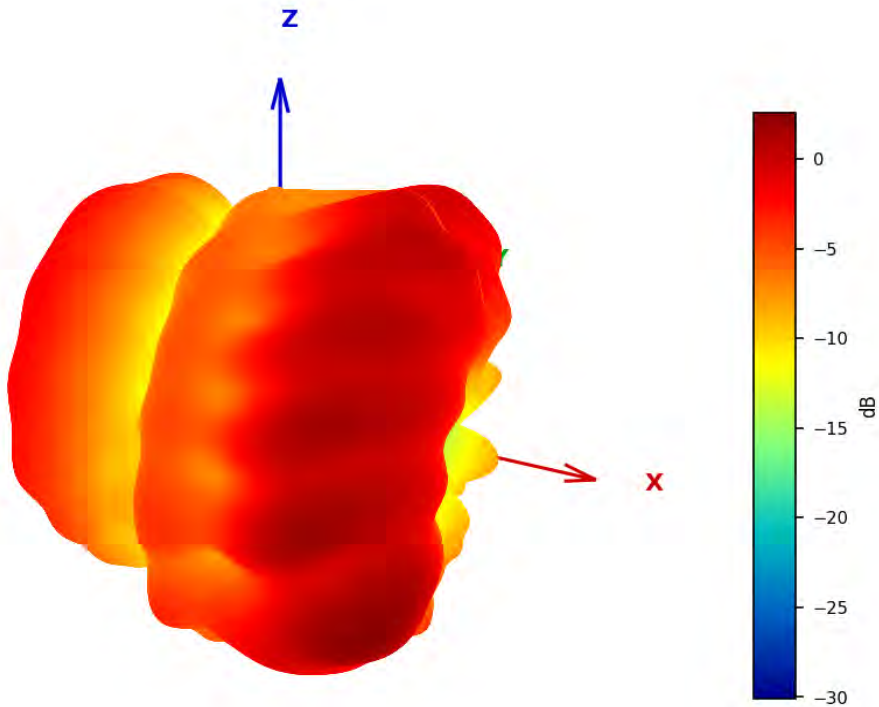
3D Radiation Pattern | 5200 MHz | Peak Gain: 3.18 dBi



3D Radiation Pattern (ETotal)

WiFi | Ant. 1 | U-NII-2A (5250-5350 MHz)

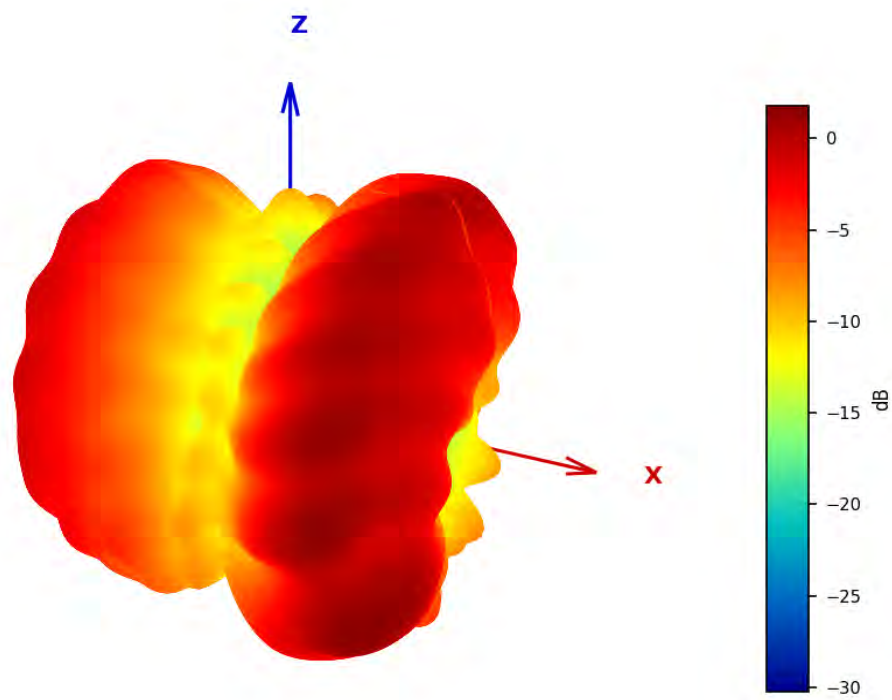
3D Radiation Pattern | 5300 MHz | Peak Gain: 3.35 dBi



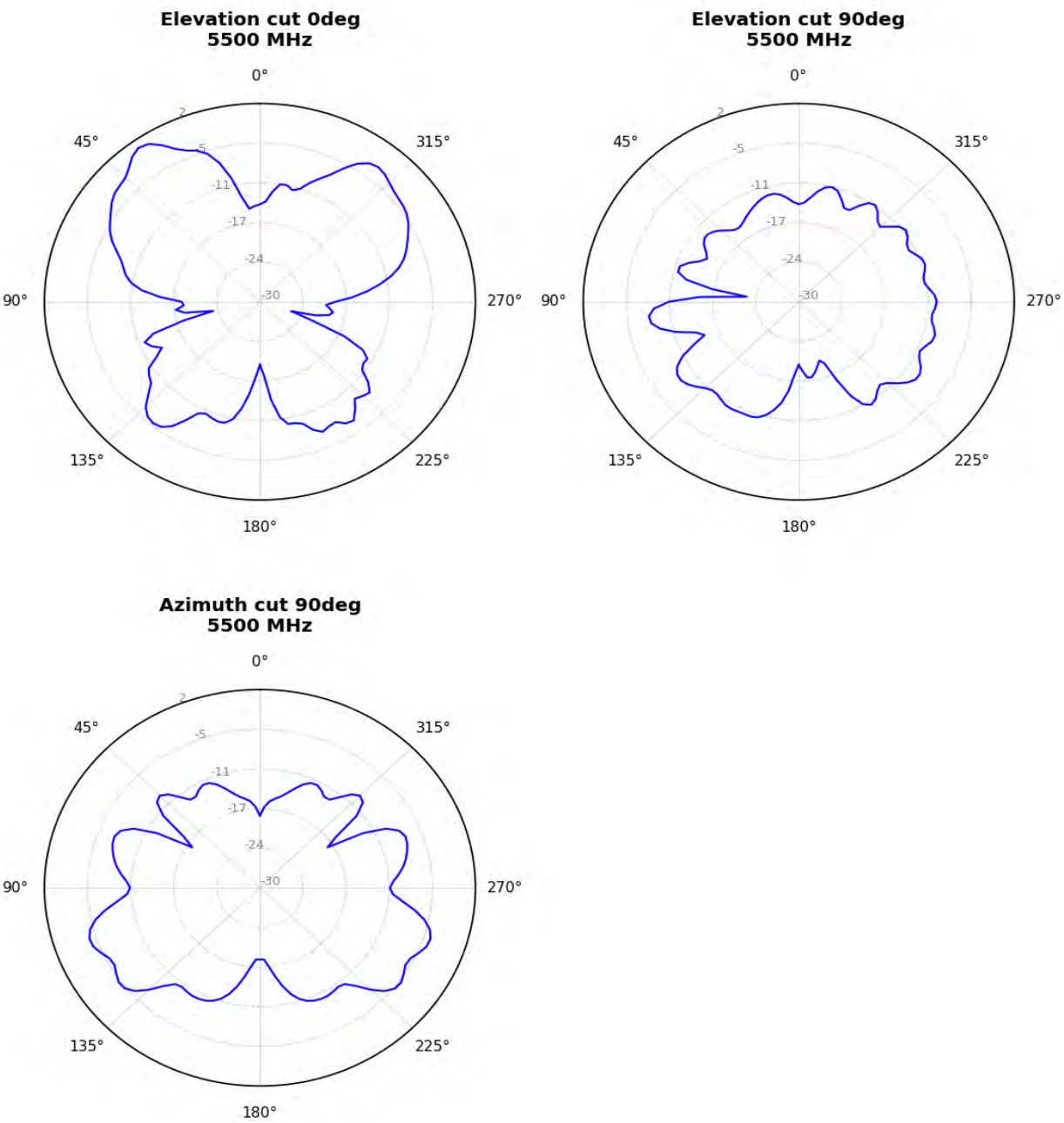
3D Radiation Pattern (ETotal)

WiFi | Ant. 1 | U-NII-2C (5470-5725 MHz)

3D Radiation Pattern | 5500 MHz | Peak Gain: 3.56 dBi

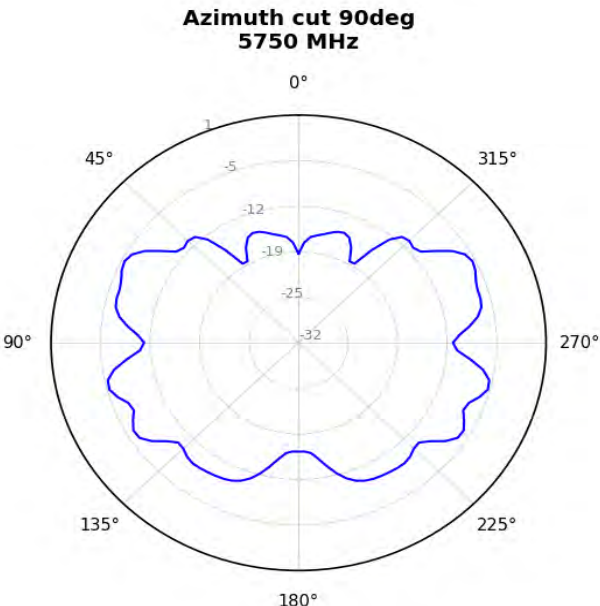
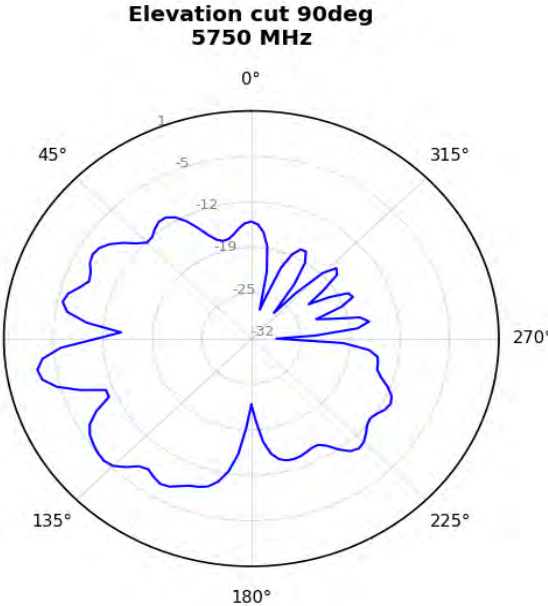
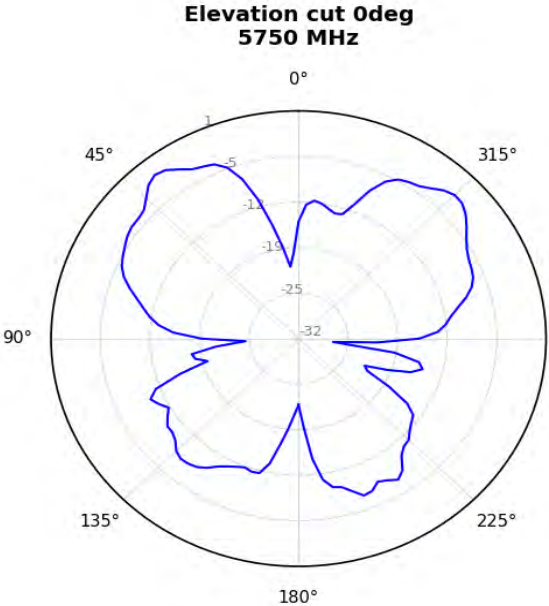
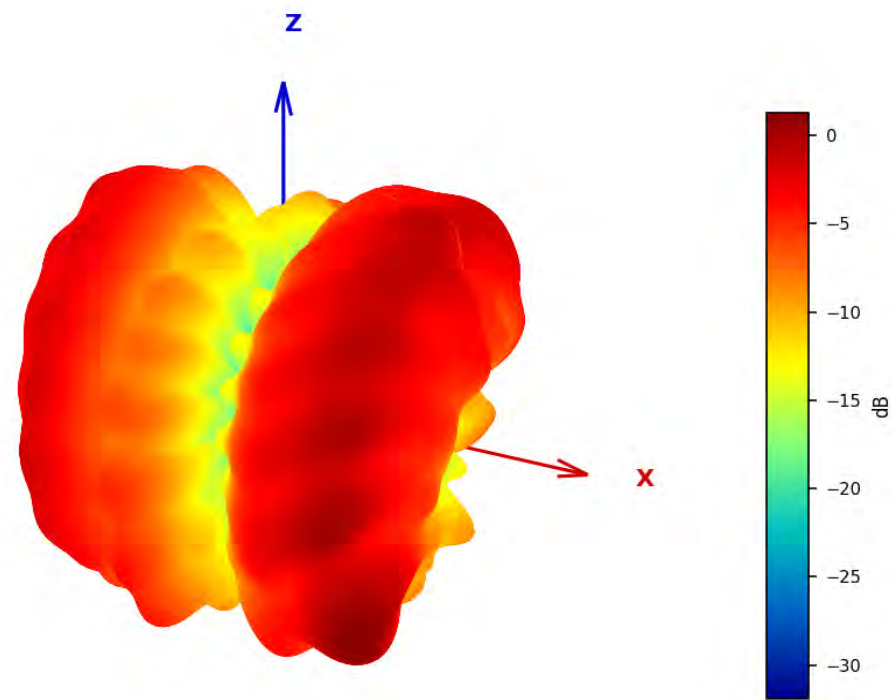


3D Radiation Pattern (ETotal)



WiFi | Ant. 1 | U-NII-3 (5725-5850 MHz)

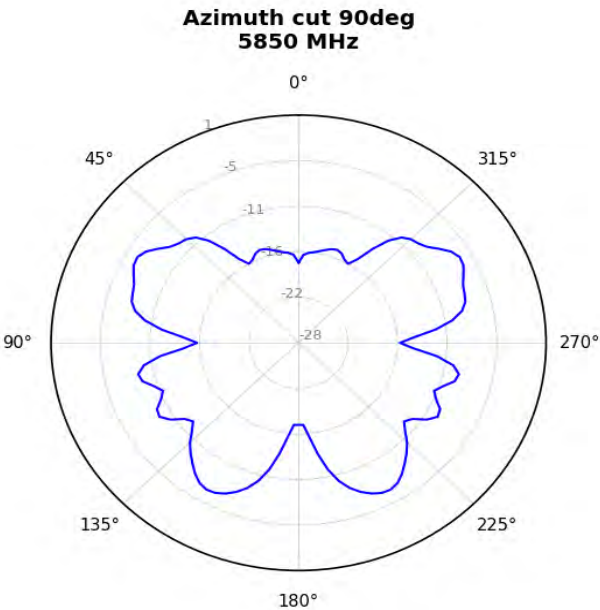
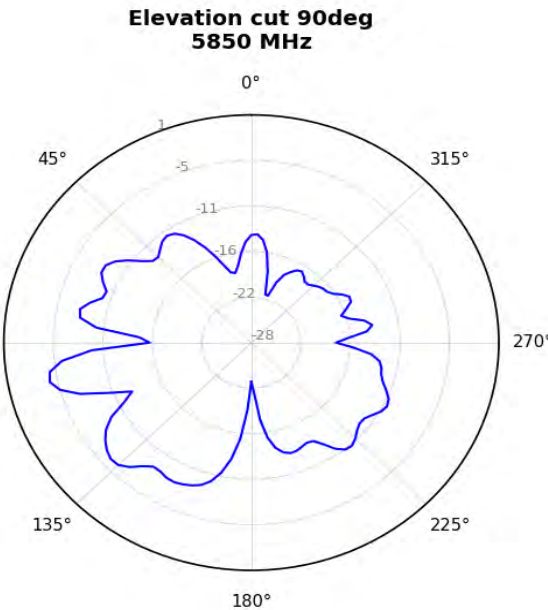
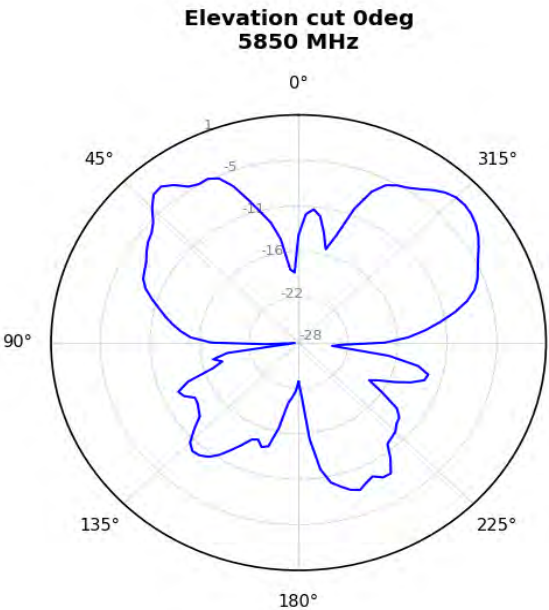
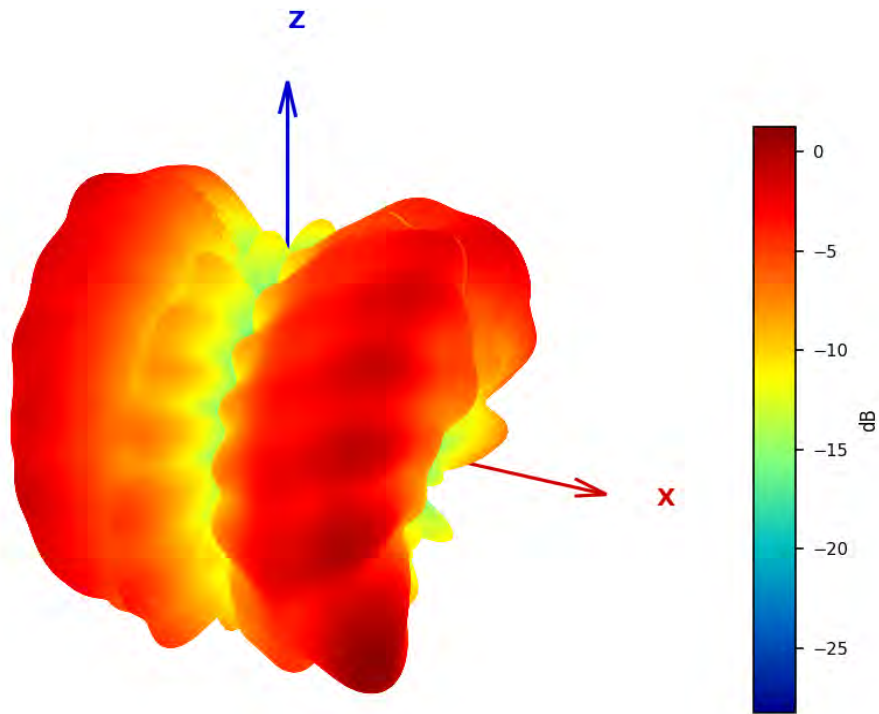
3D Radiation Pattern | 5750 MHz | Peak Gain: 3.02 dBi



3D Radiation Pattern (ETotal)

WiFi | Ant. 1 | U-NII-4 (5850-5895 MHz)

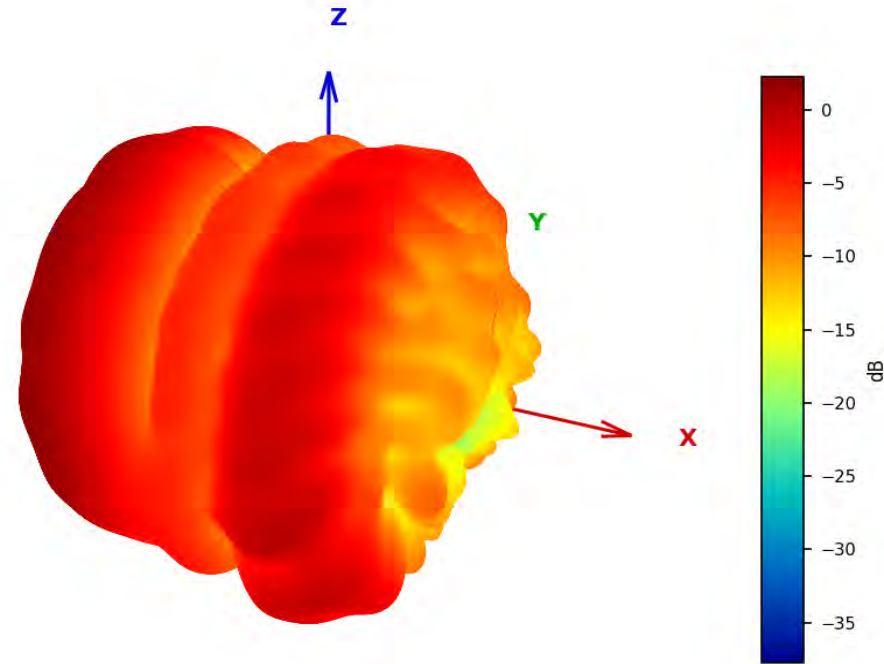
3D Radiation Pattern | 5850 MHz | Peak Gain: 2.38 dBi



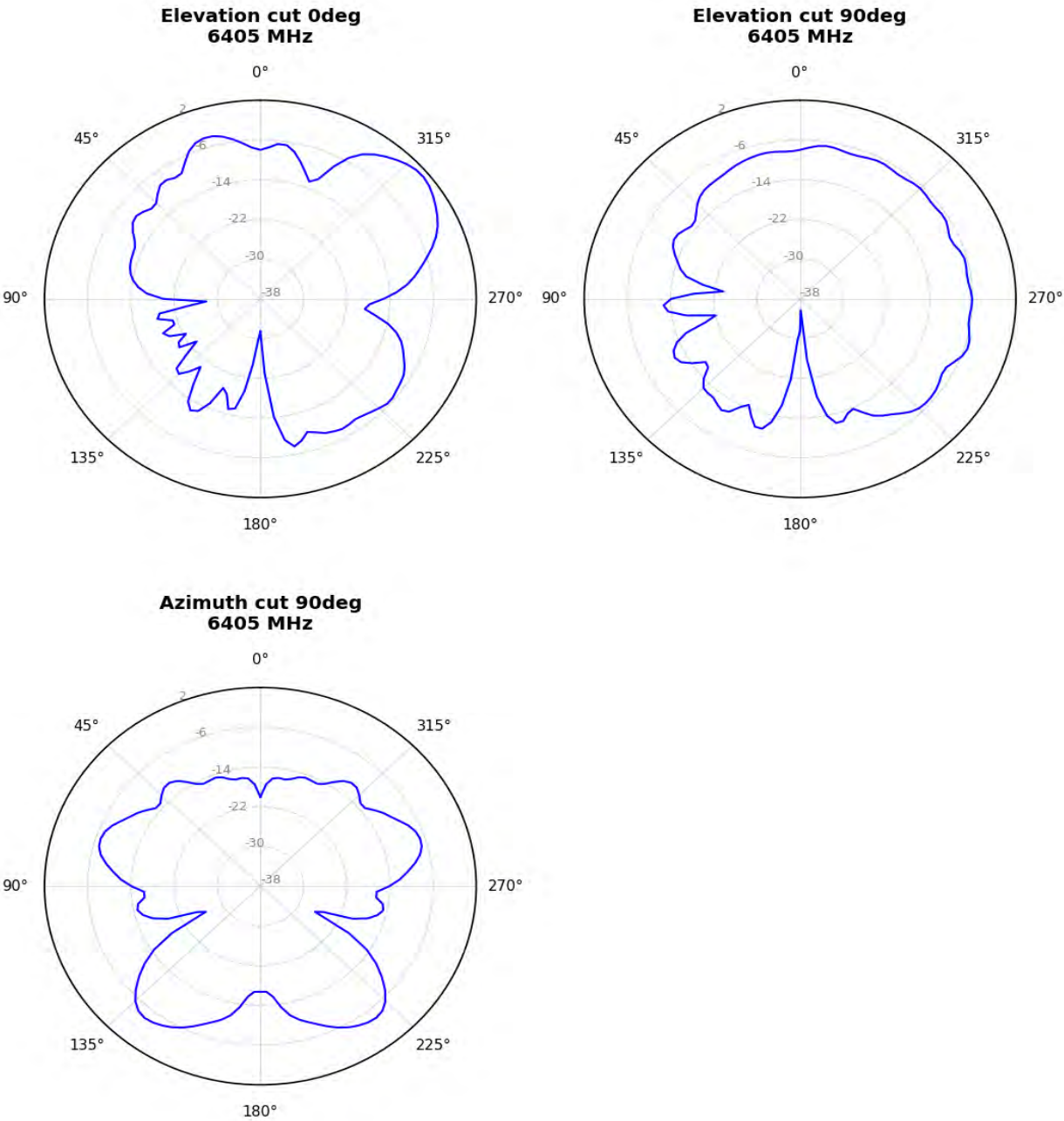
3D Radiation Pattern (ETotal)

WiFi | Ant. 1 | U-NII-5 (5925-6425 MHz)

3D Radiation Pattern | 6405 MHz | Peak Gain: 3.11 dBi

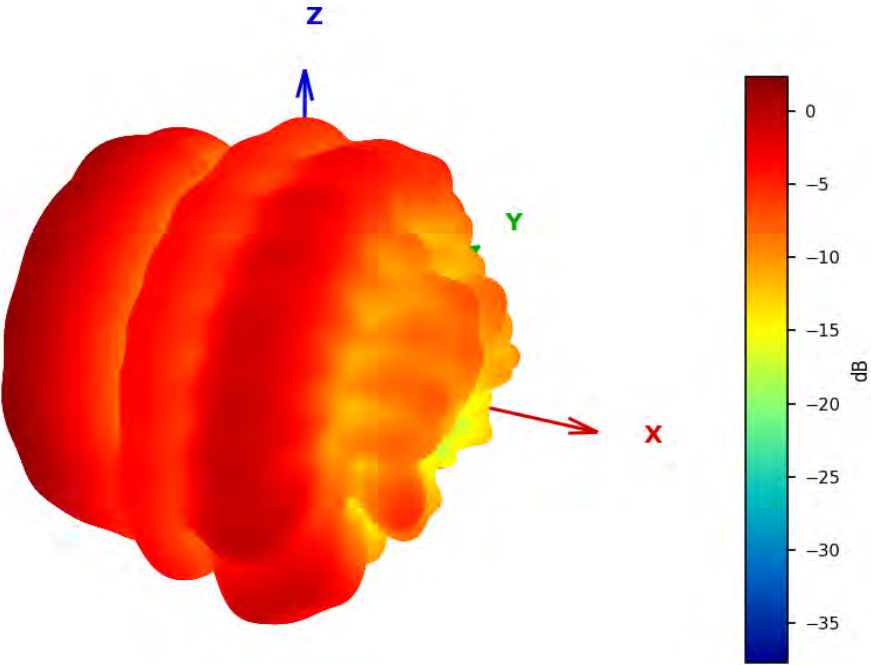


3D Radiation Pattern (ETotal)

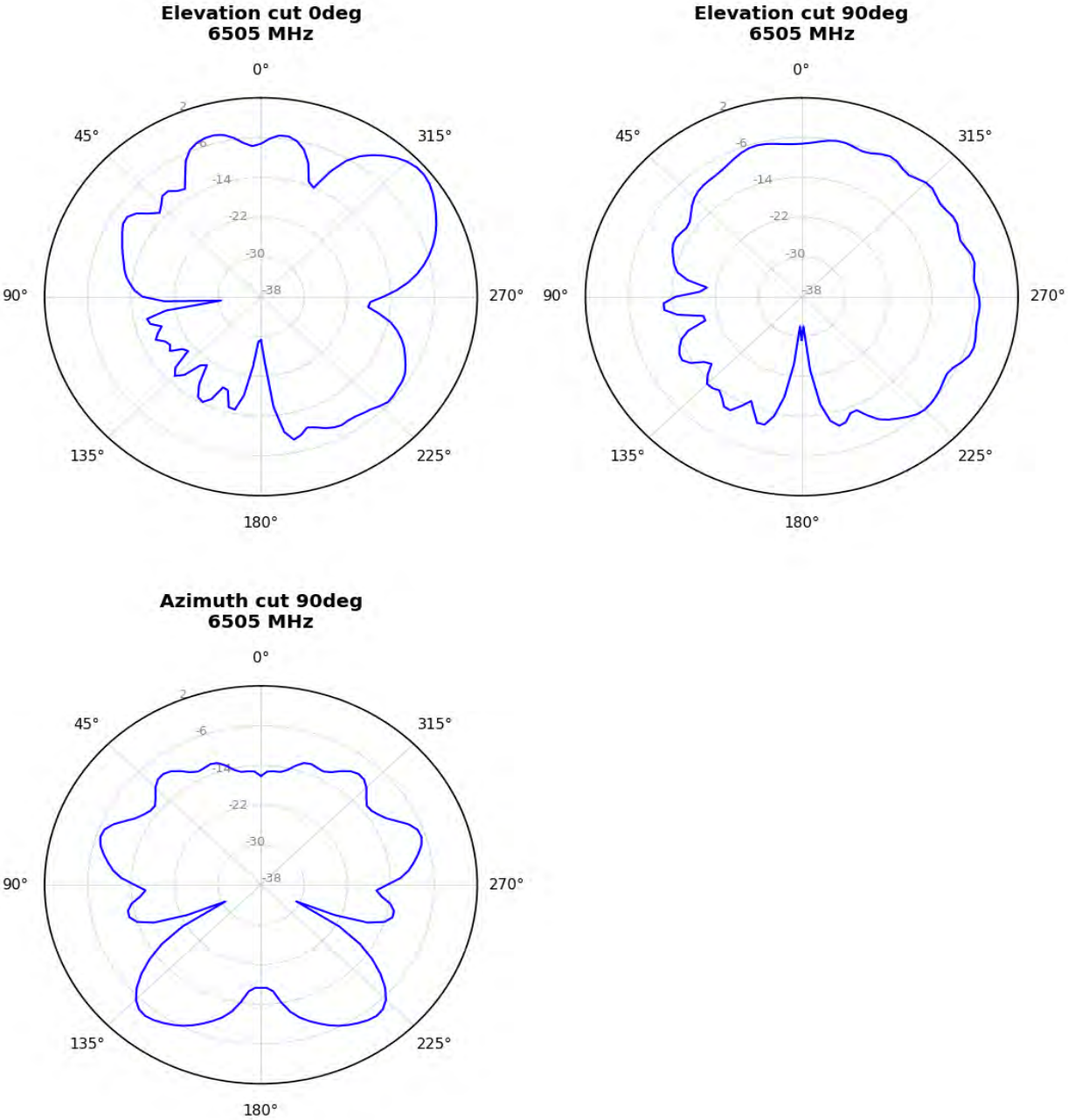


WiFi | Ant. 1 | U-NII-6 (6425-6525 MHz)

3D Radiation Pattern | 6505 MHz | Peak Gain: 3.17 dBi

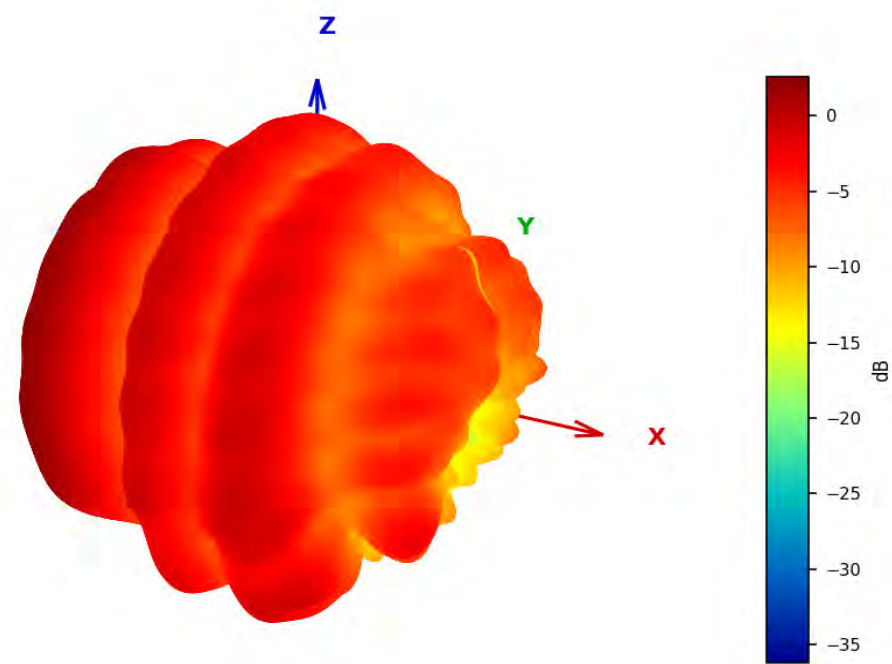


3D Radiation Pattern (ETotal)

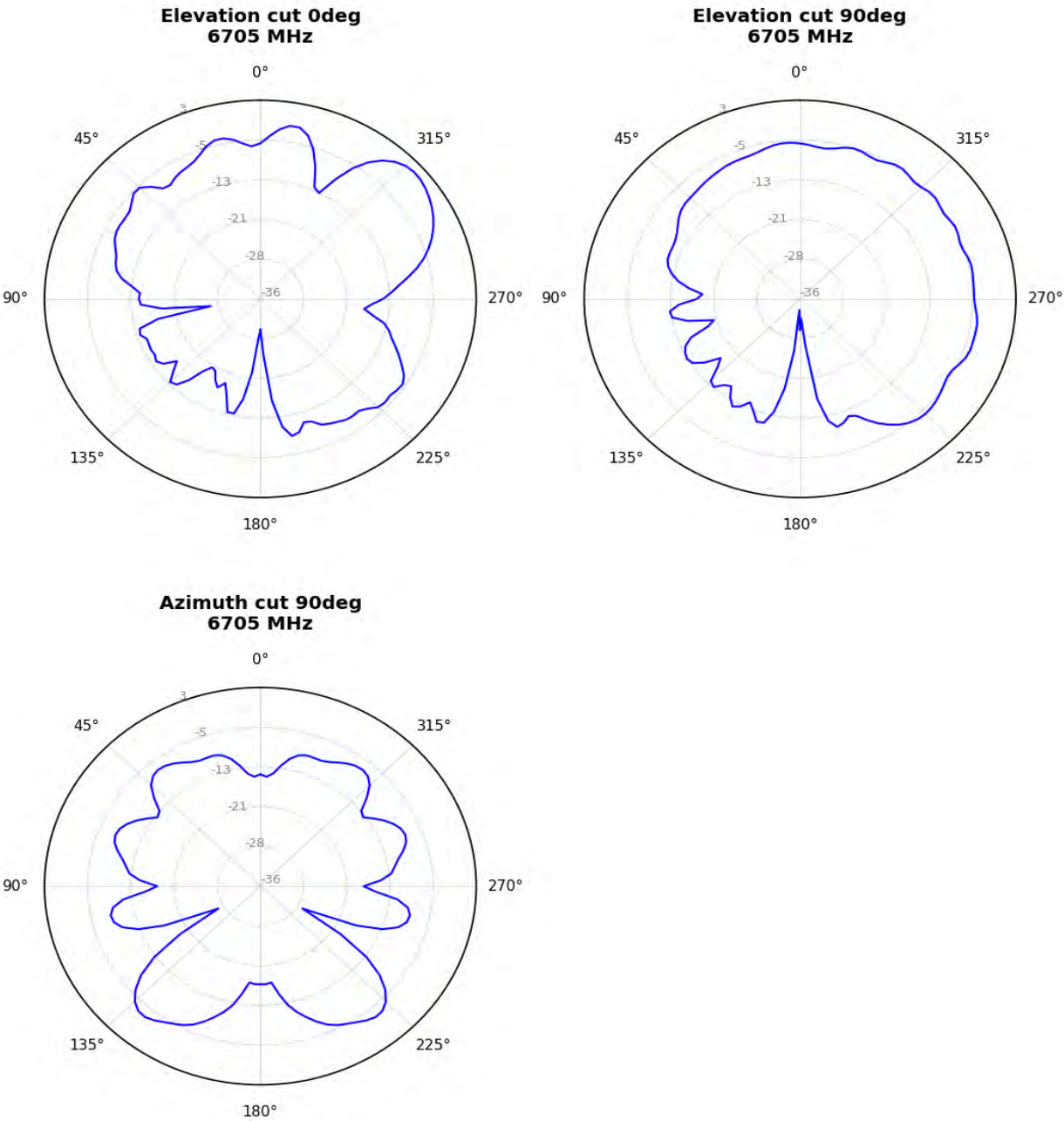


WiFi | Ant. 1 | U-NII-7 (6525-6875 MHz)

3D Radiation Pattern | 6705 MHz | Peak Gain: 3.49 dBi

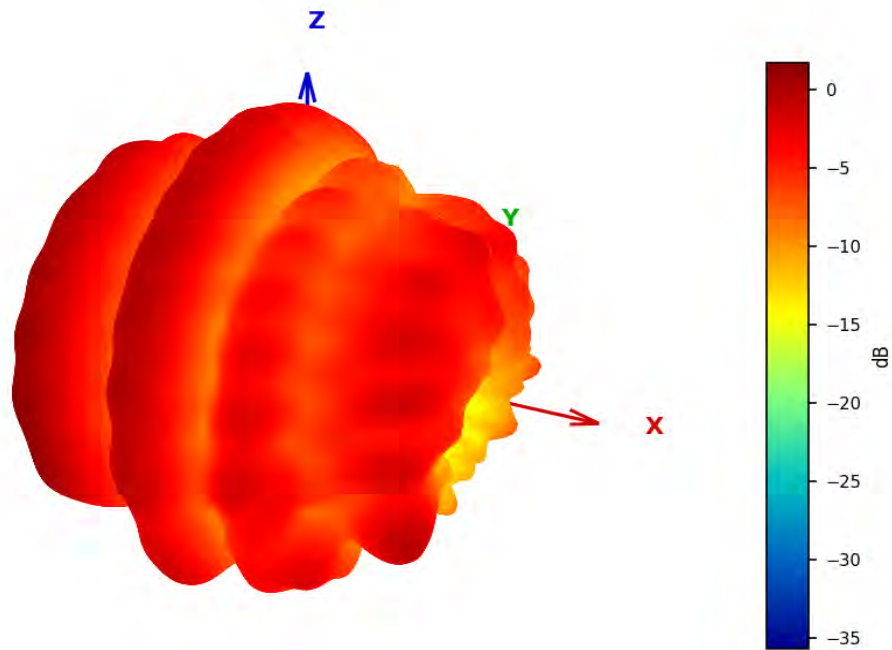


3D Radiation Pattern (ETotal)

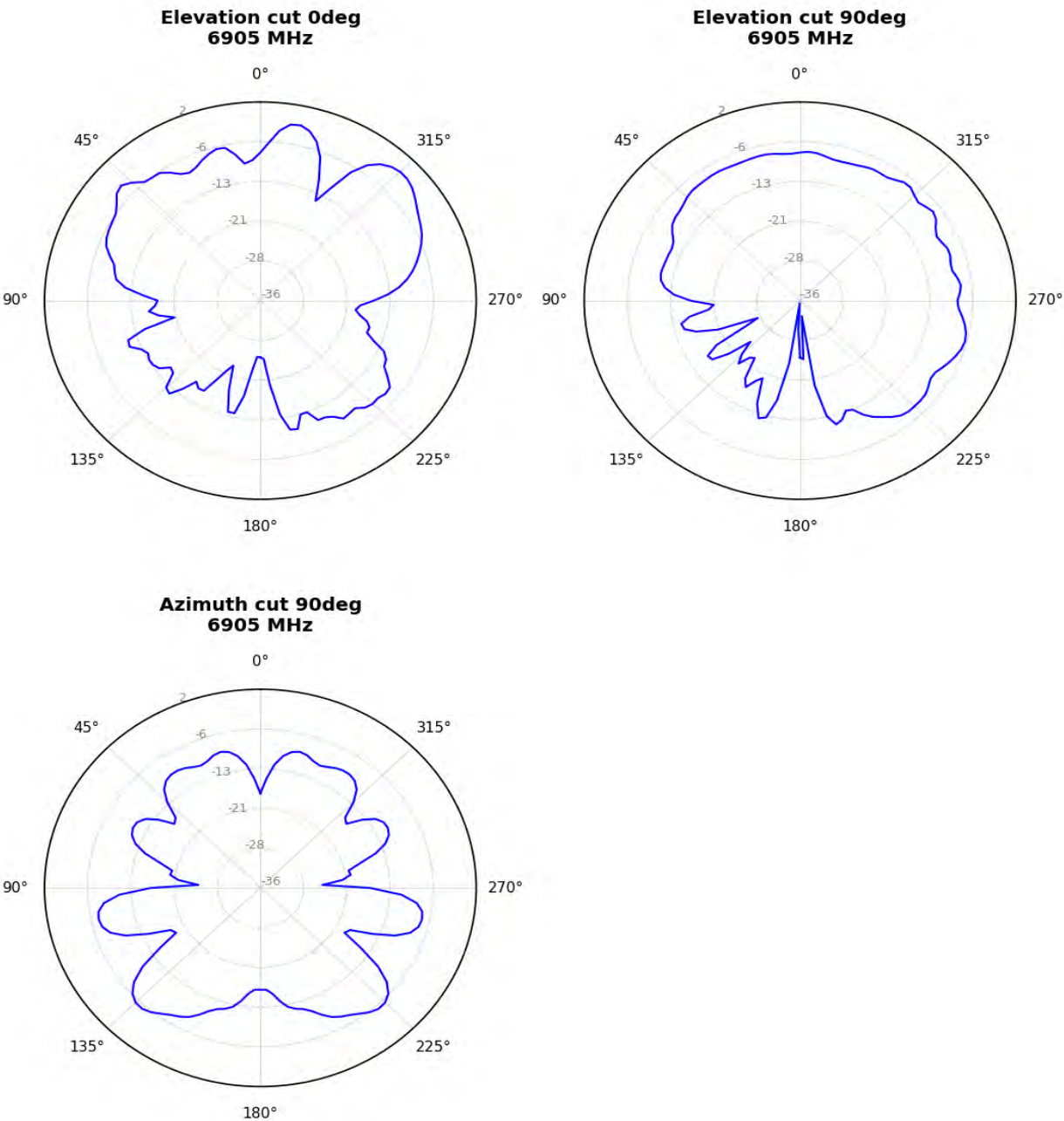


WiFi | Ant. 1 | U-NII-8 (6875-7125 MHz)

3D Radiation Pattern | 6905 MHz | Peak Gain: 2.71 dBi



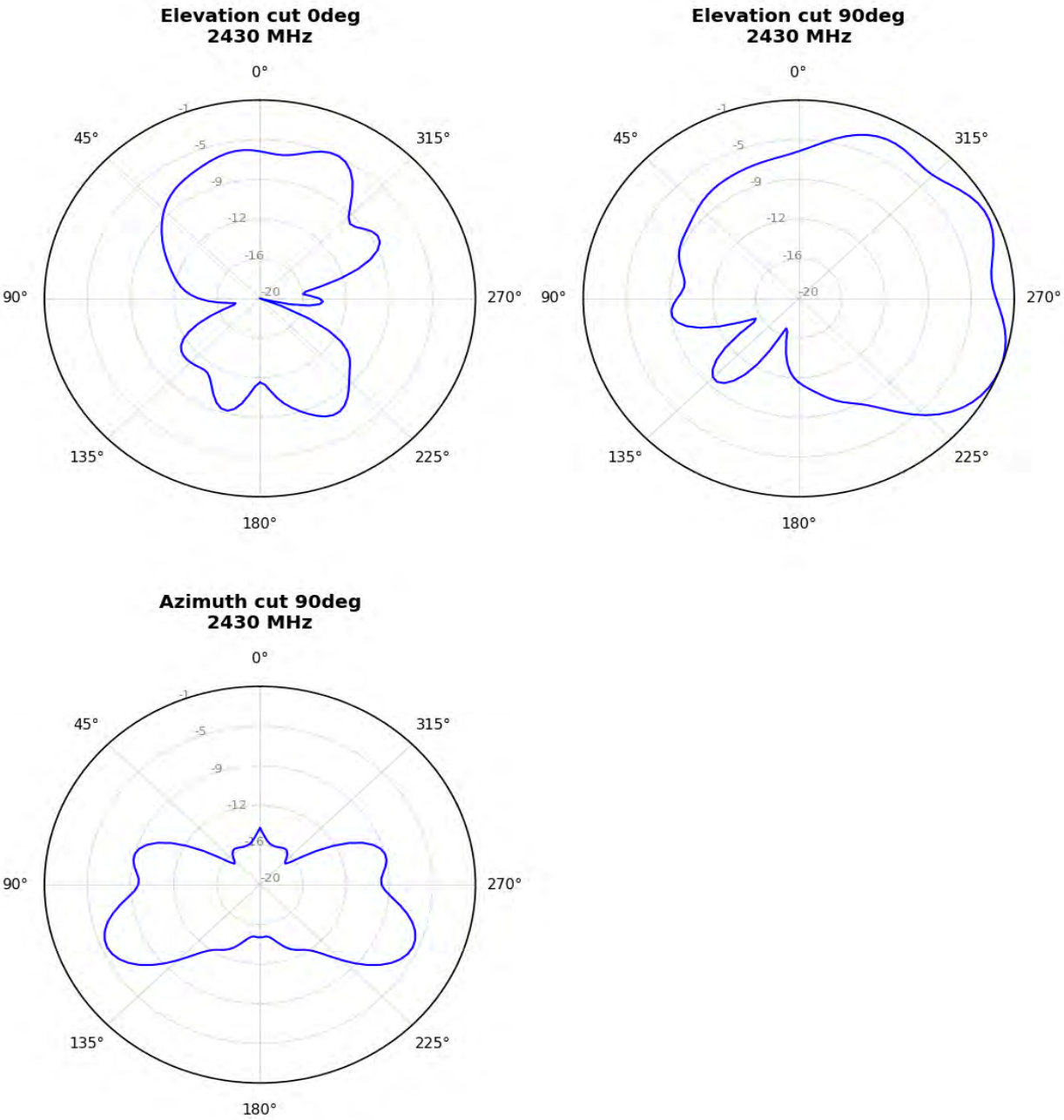
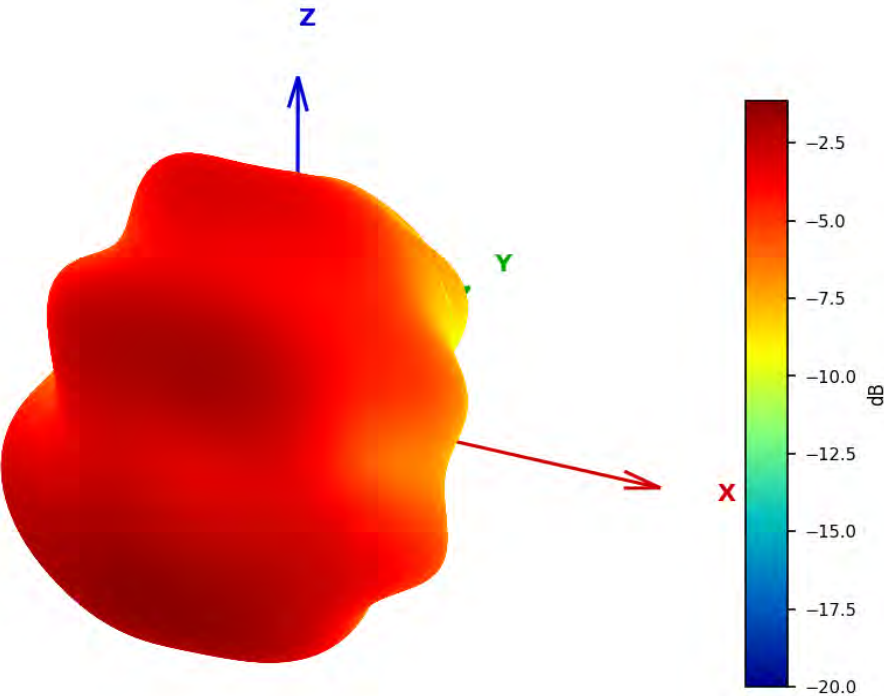
3D Radiation Pattern (ETotal)



Antenna 2

WiFi | Ant. 2 | 2.4GHz (2400-2483.5 MHz)

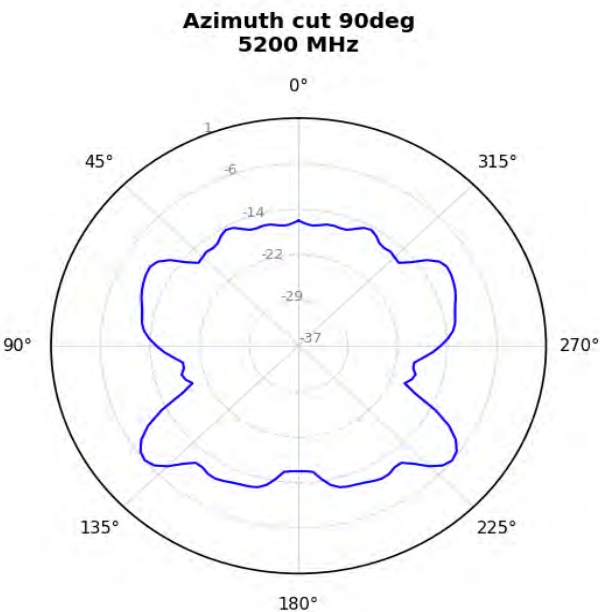
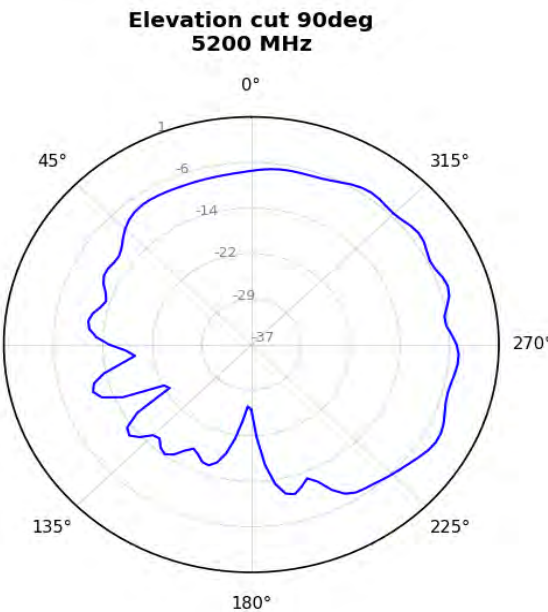
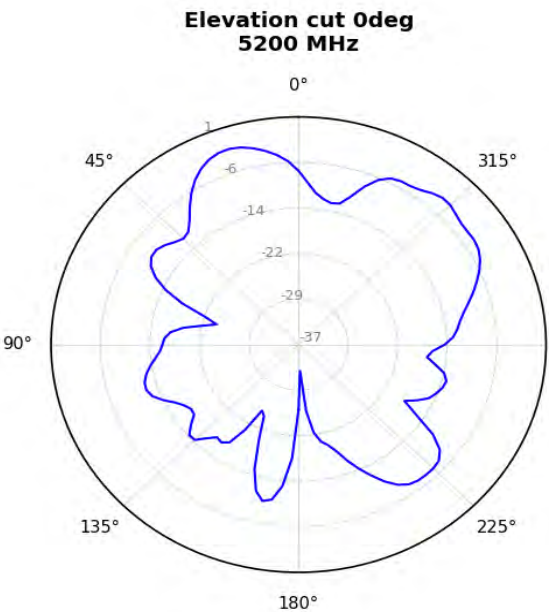
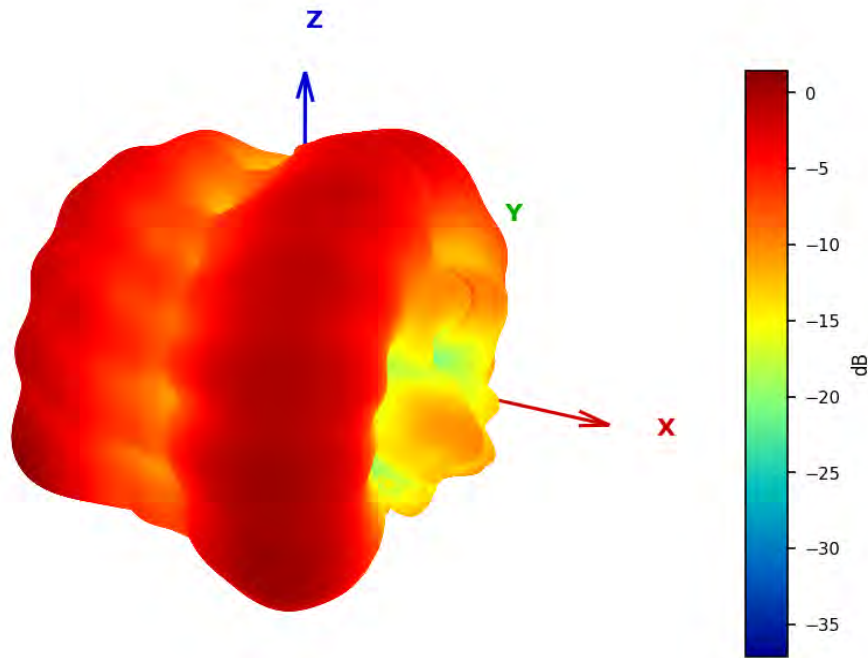
3D Radiation Pattern | 2430 MHz | Peak Gain: -0.13 dBi



3D Radiation Pattern (ETotal)

WiFi | Ant. 2 | U-NII-1 (5150-5250 MHz)

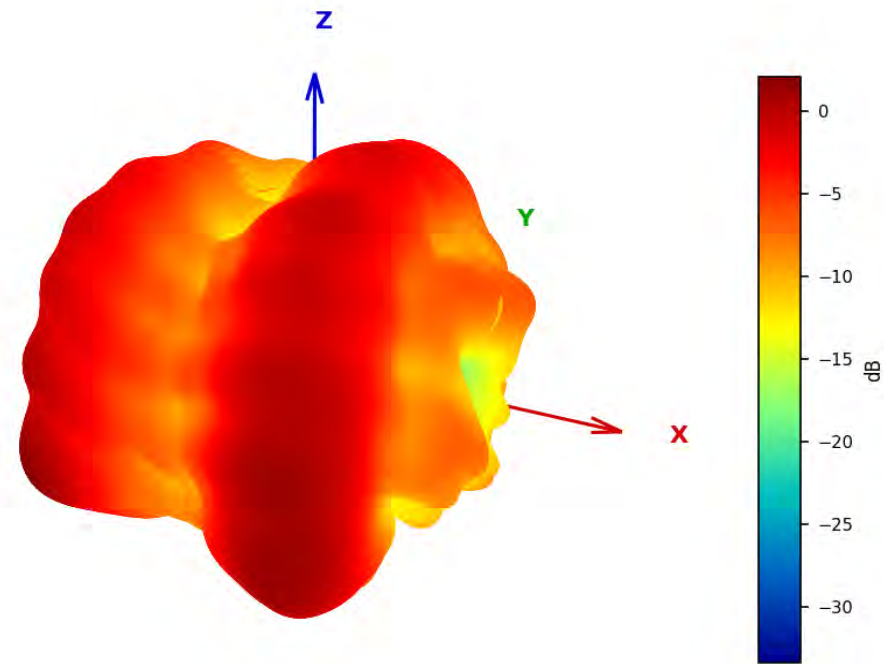
3D Radiation Pattern | 5200 MHz | Peak Gain: 2.99 dBi



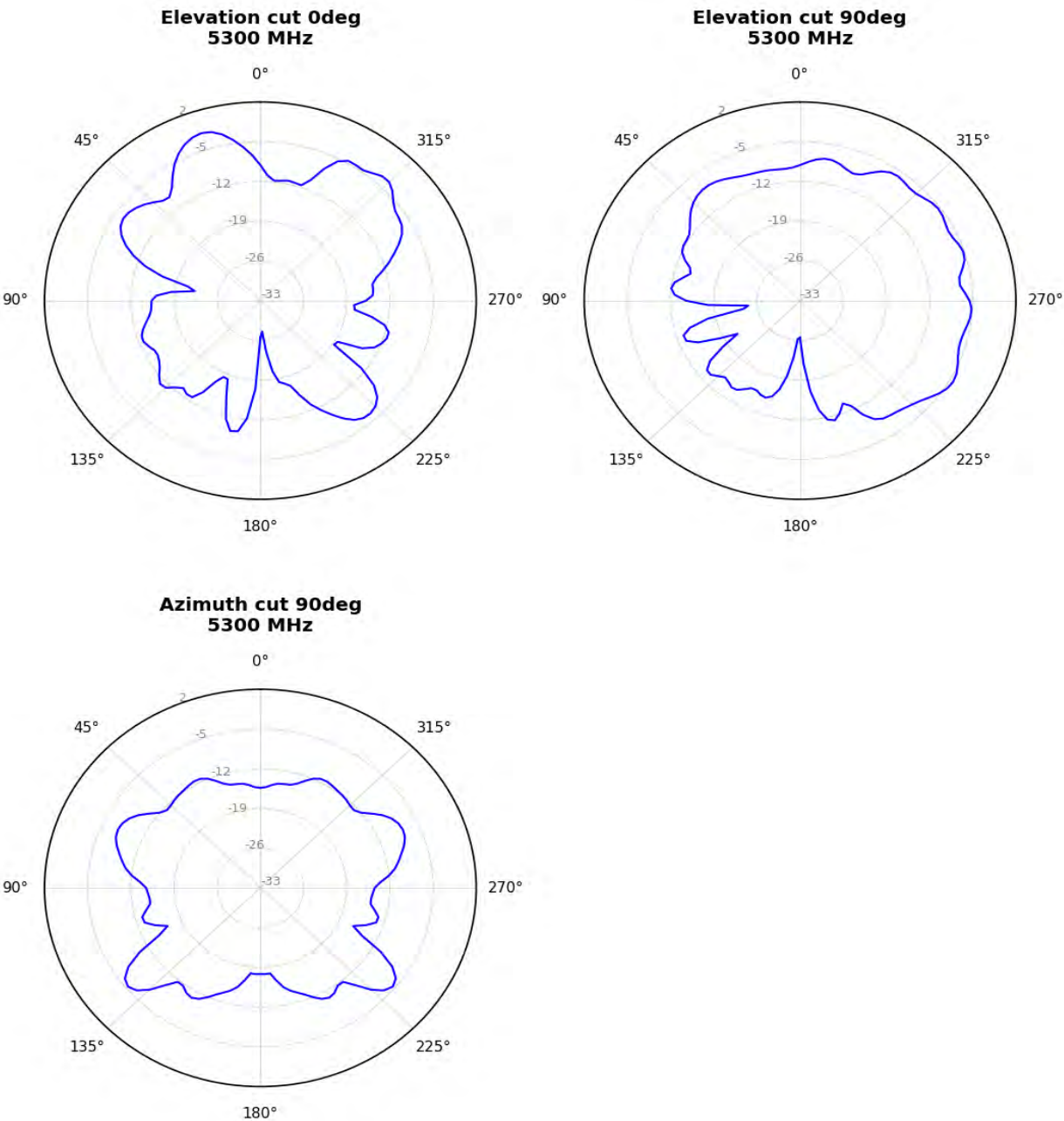
3D Radiation Pattern (ETotal)

WiFi | Ant. 2 | U-NII-2A (5250-5350 MHz)

3D Radiation Pattern | 5300 MHz | Peak Gain: 3.34 dBi

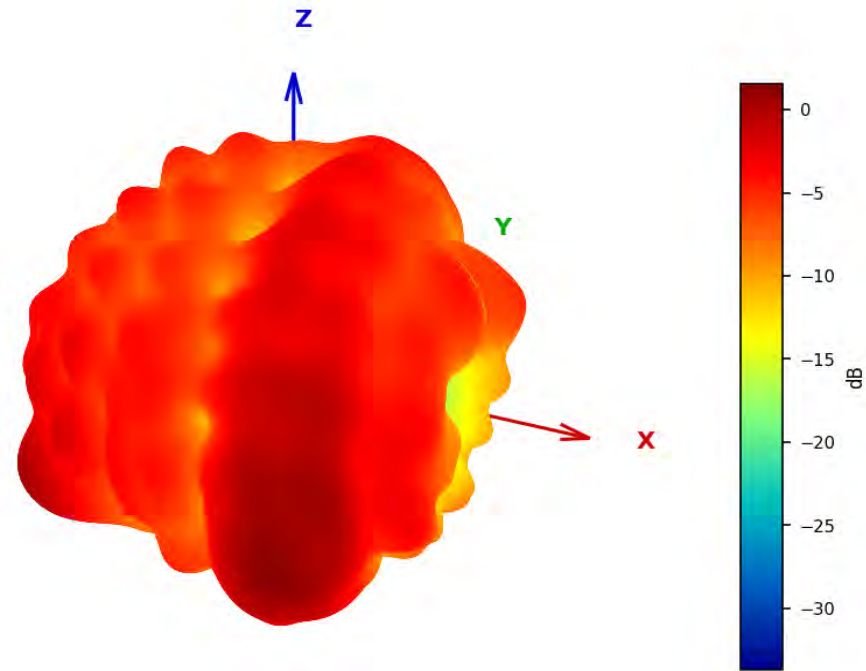


3D Radiation Pattern (ETotal)

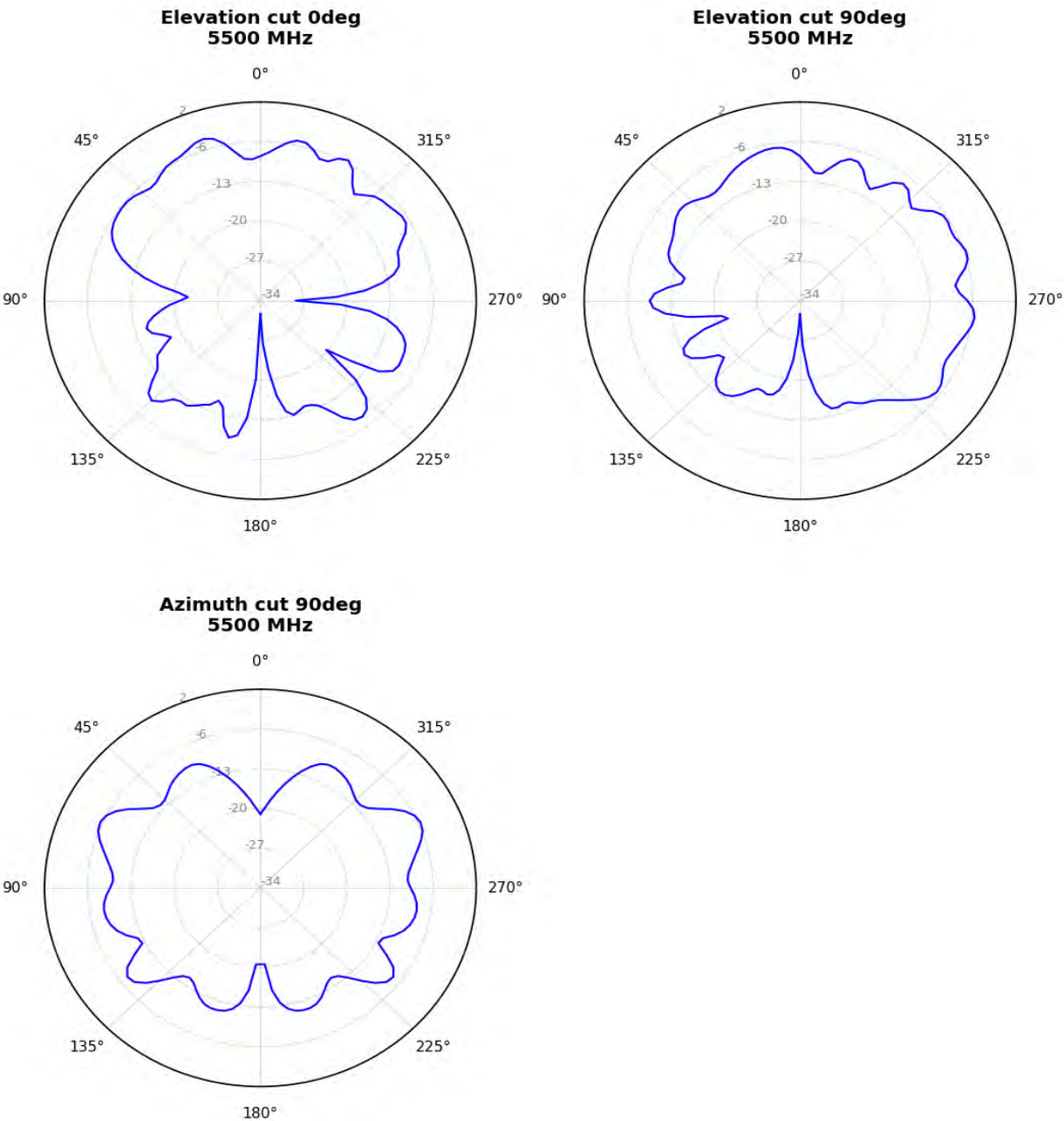


WiFi | Ant. 2 | U-NII-2C (5470-5725 MHz)

3D Radiation Pattern | 5500 MHz | Peak Gain: 3.01 dBi

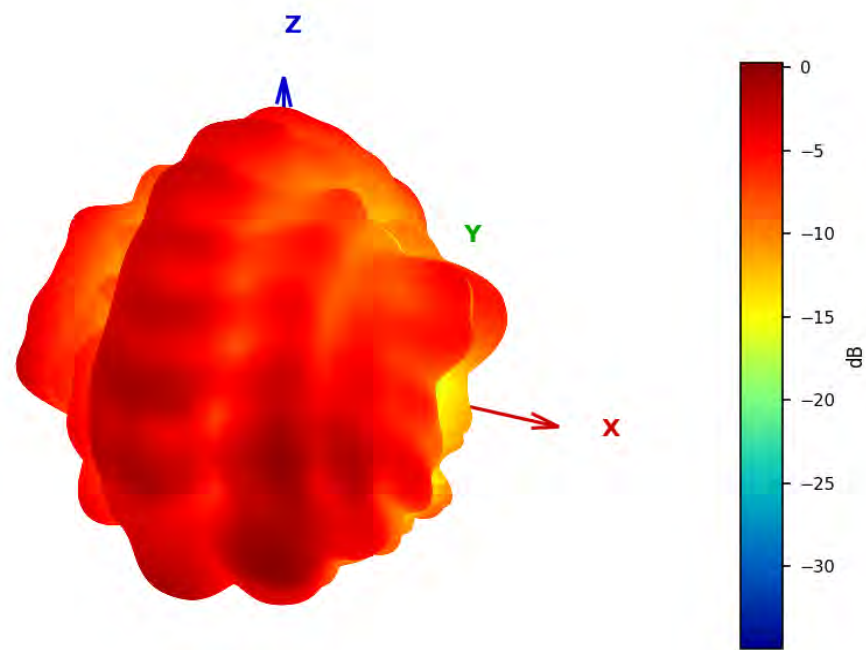


3D Radiation Pattern (ETotal)

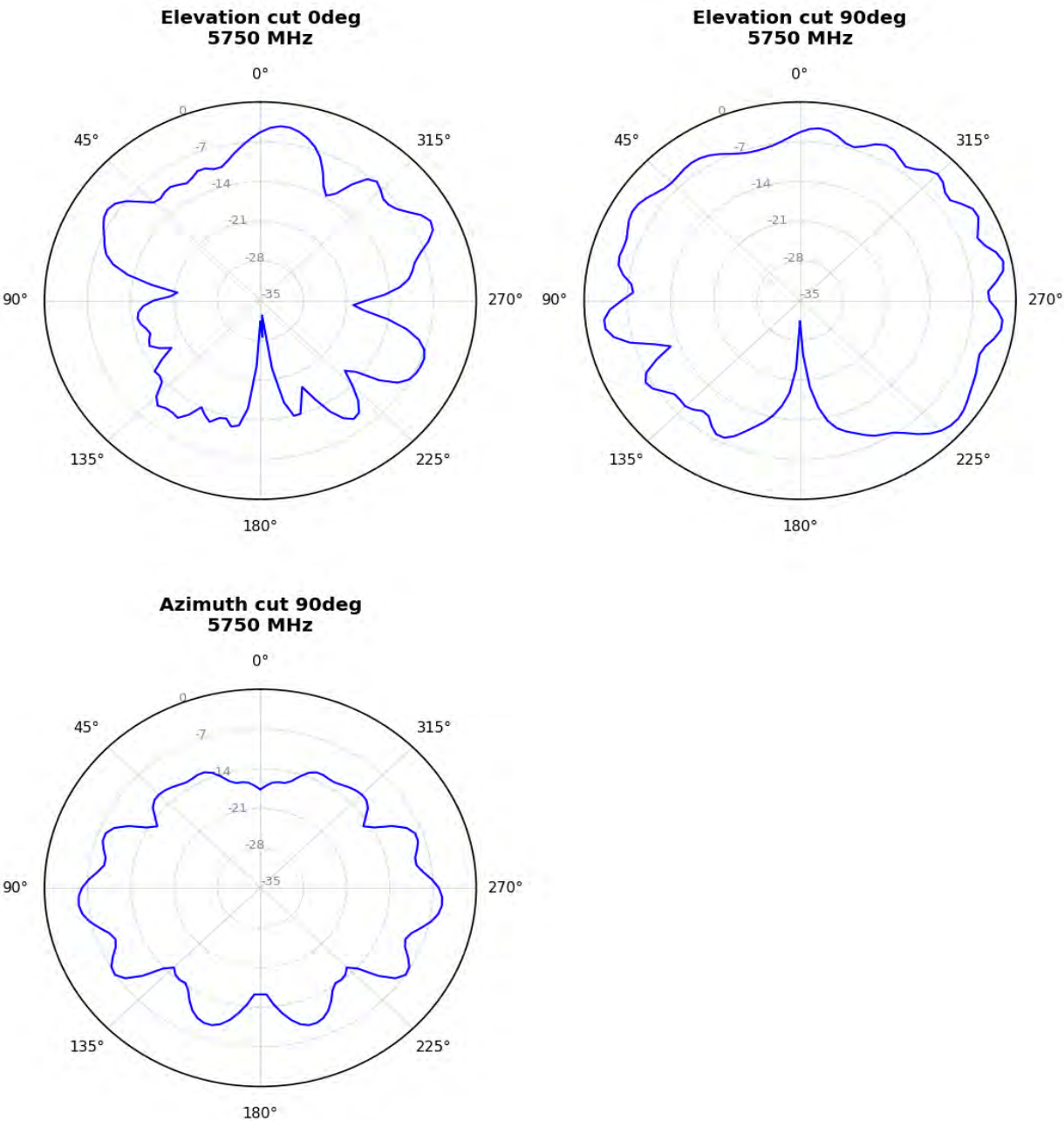


WiFi | Ant. 2 | U-NII-3 (5725-5850 MHz)

3D Radiation Pattern | 5750 MHz | Peak Gain: 1.85 dBi

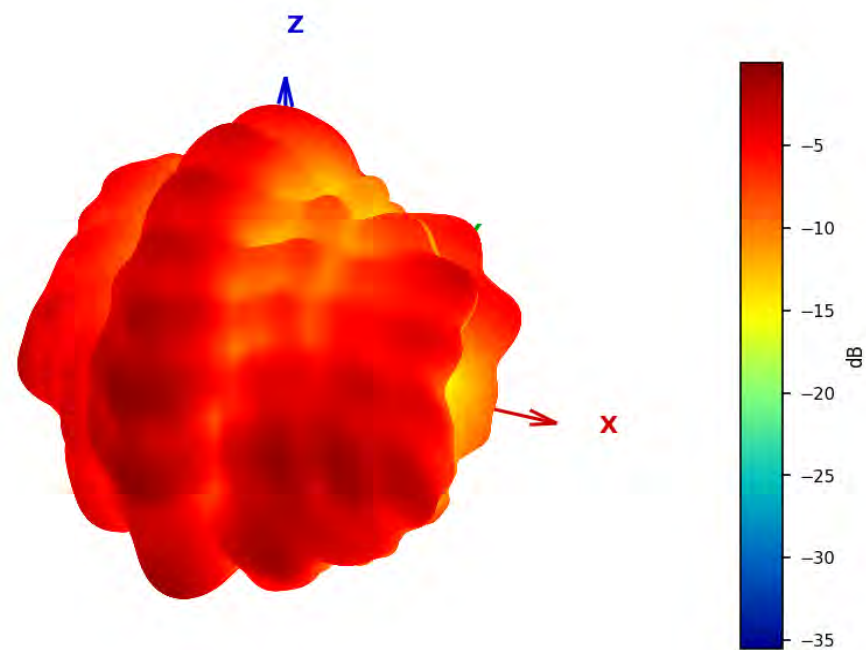


3D Radiation Pattern (ETotal)

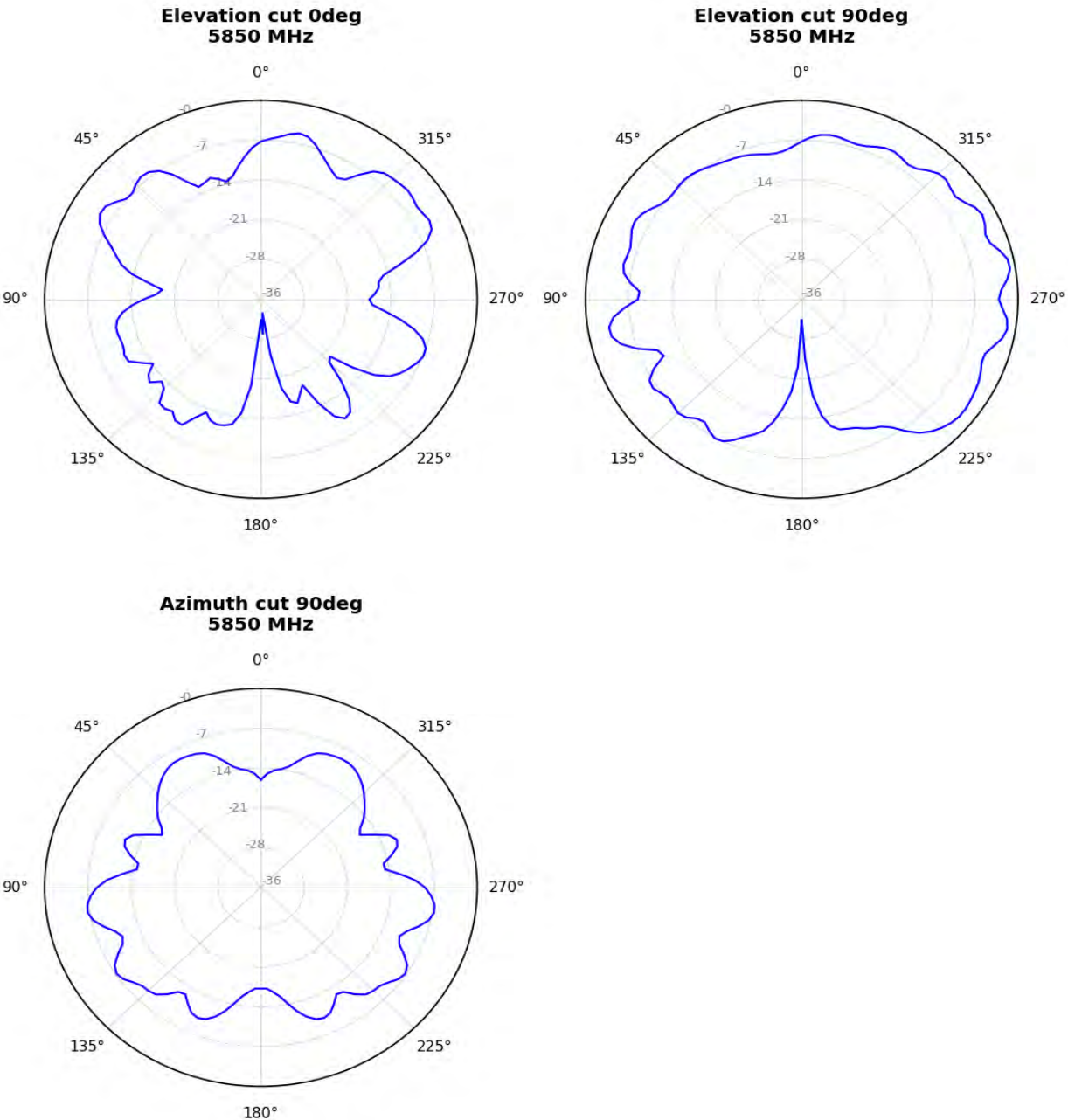


WiFi | Ant. 2 | U-NII-4 (5850-5895 MHz)

3D Radiation Pattern | 5850 MHz | Peak Gain: 1.85 dBi

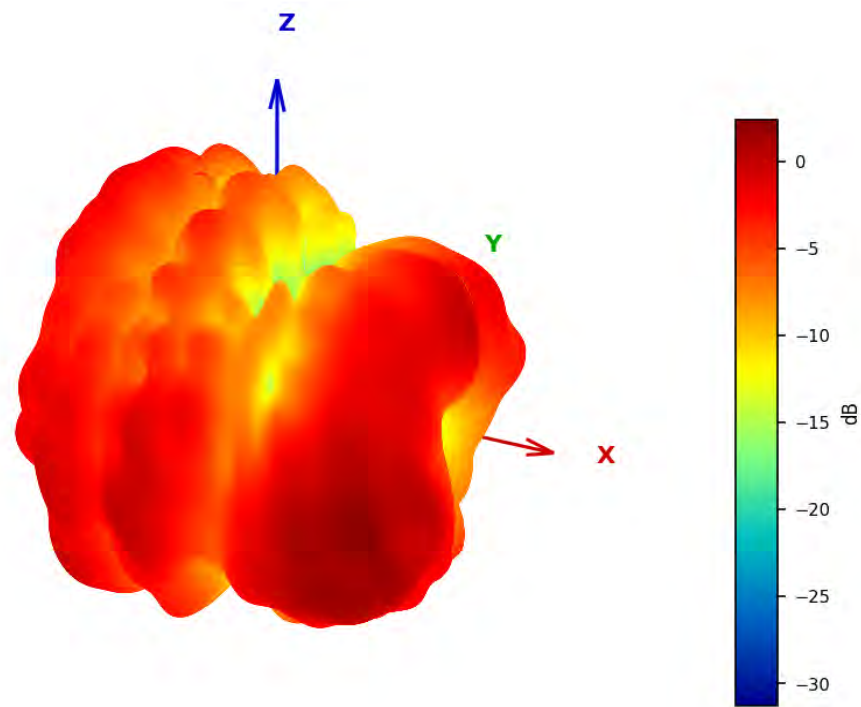


3D Radiation Pattern (ETotal)

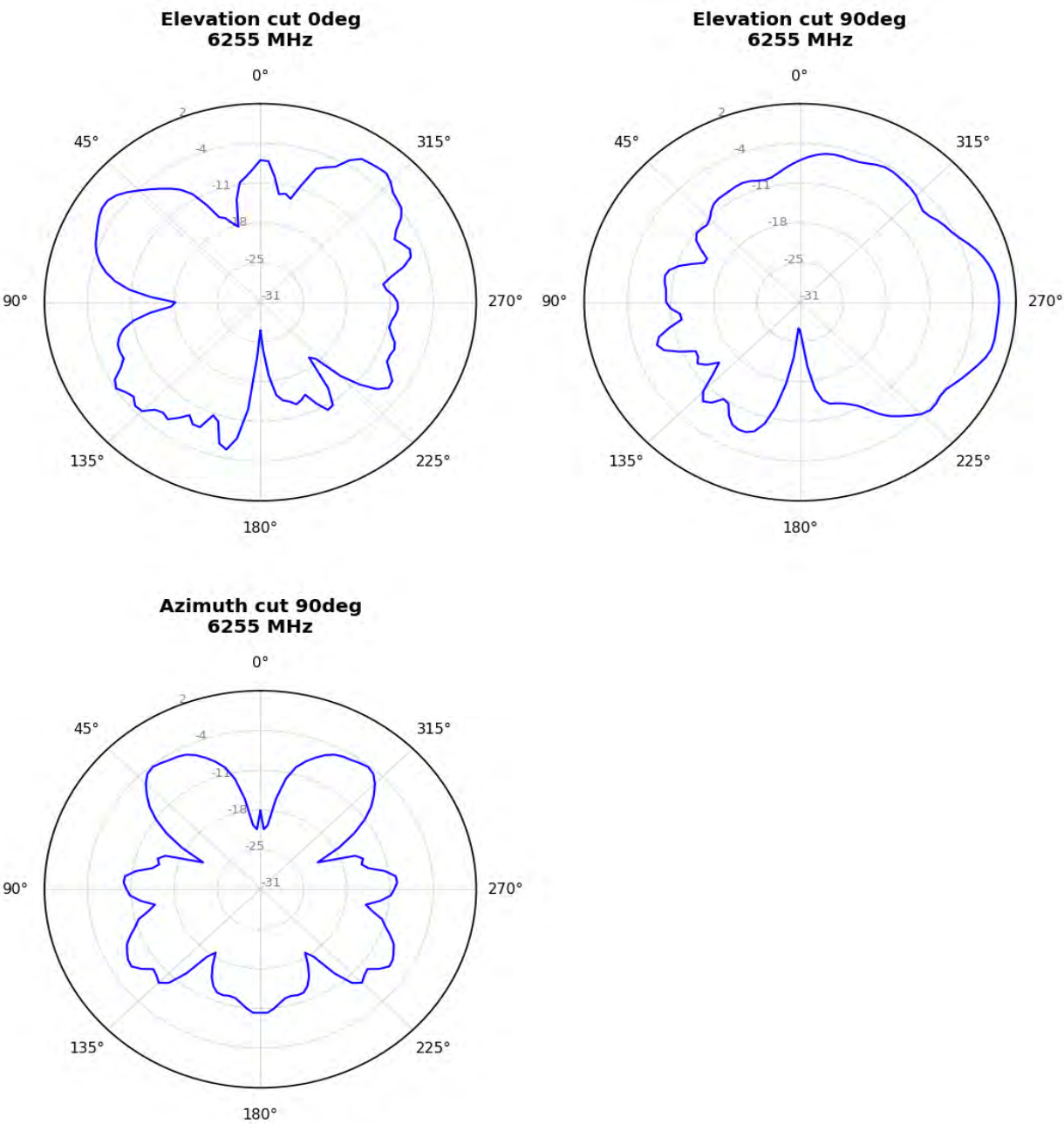


WiFi | Ant. 2 | U-NII-5 (5925-6425 MHz)

3D Radiation Pattern | 6255 MHz | Peak Gain: 3.45 dBi

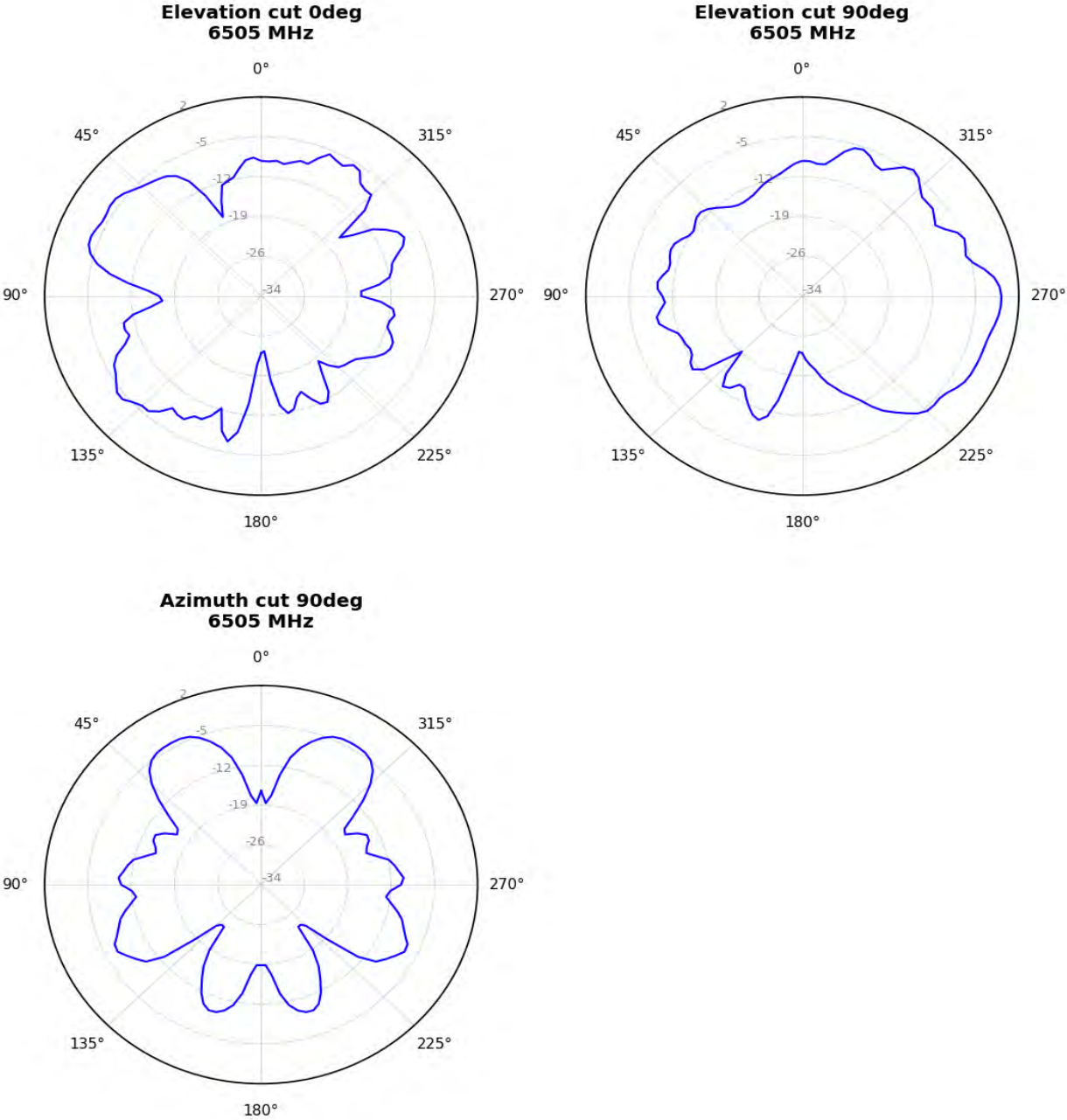
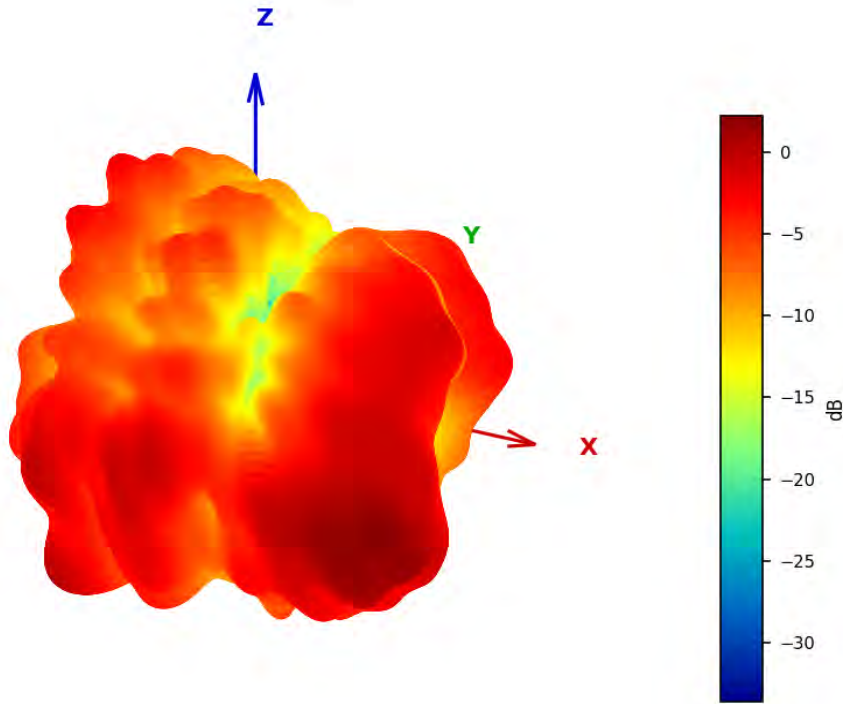


3D Radiation Pattern (ETotal)



WiFi | Ant. 2 | U-NII-6 (6425-6525 MHz)

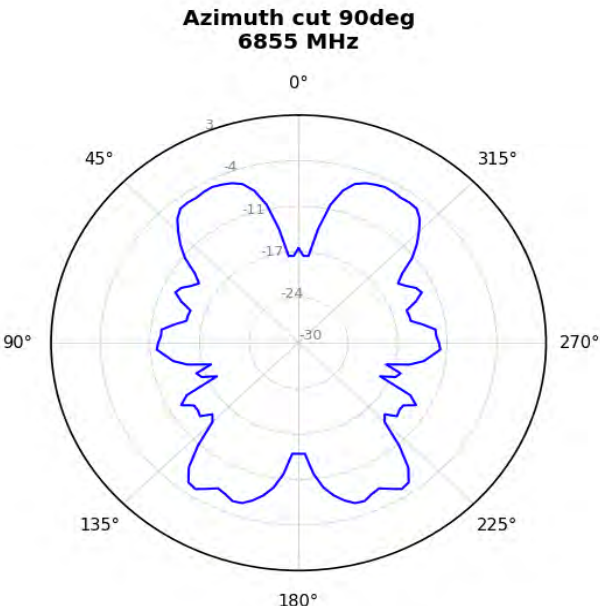
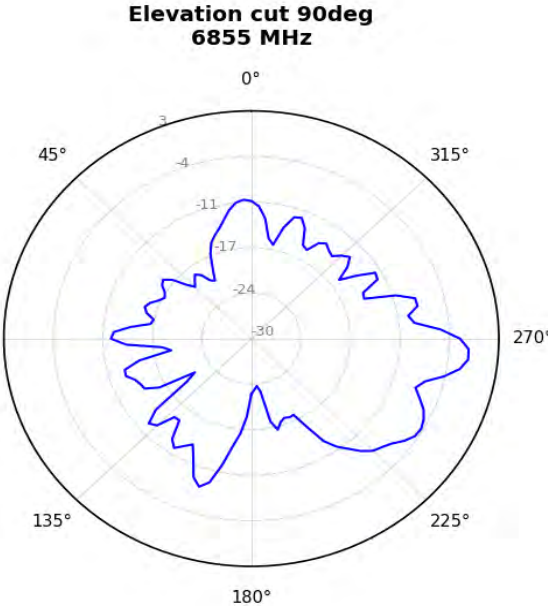
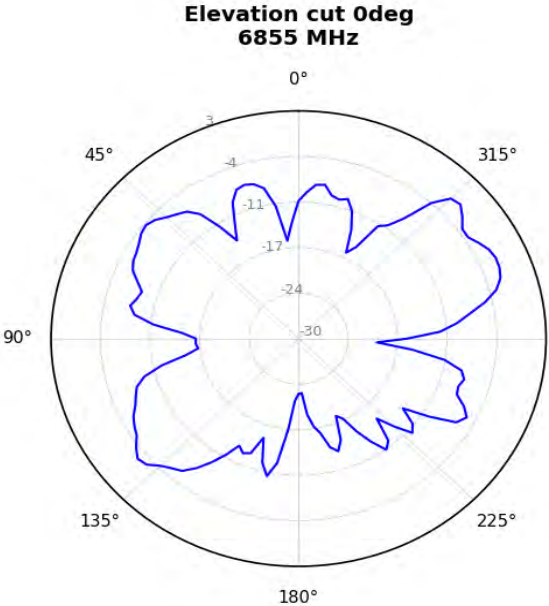
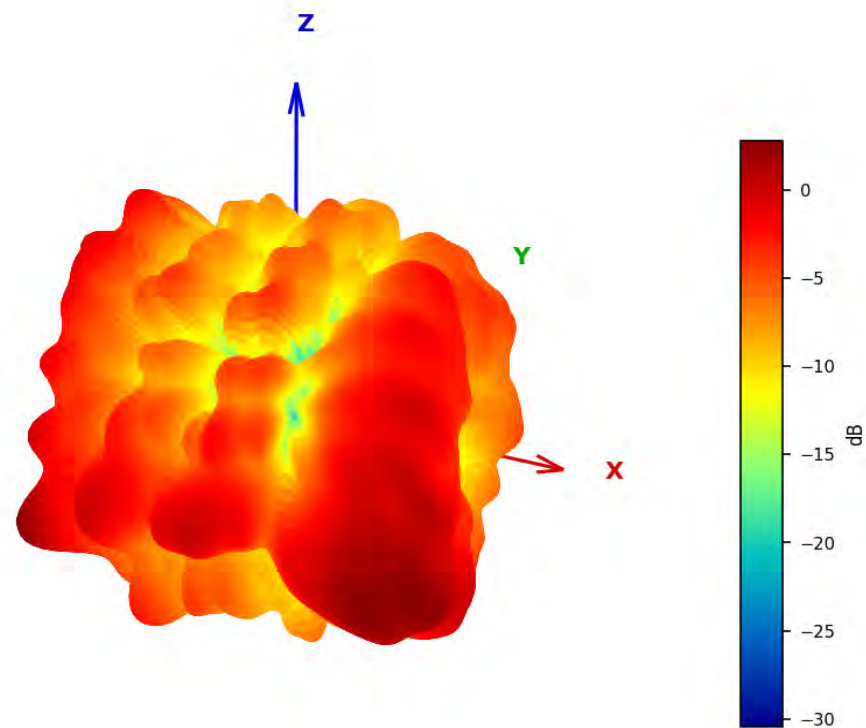
3D Radiation Pattern | 6505 MHz | Peak Gain: 3.16 dBi



3D Radiation Pattern (ETotal)

WiFi | Ant. 2 | U-NII-7 (6525-6875 MHz)

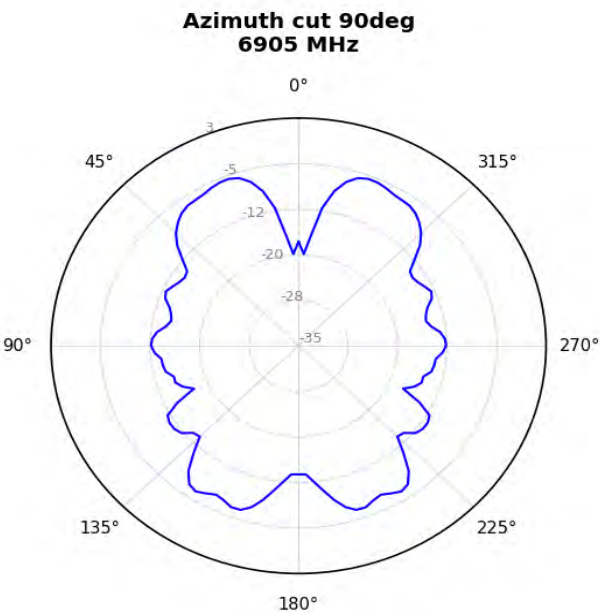
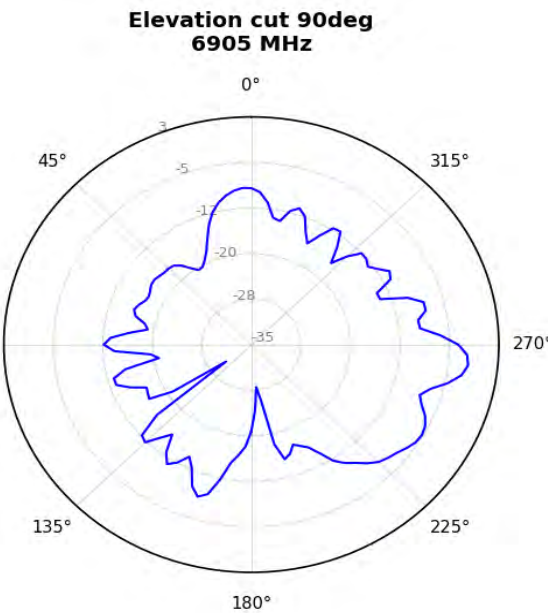
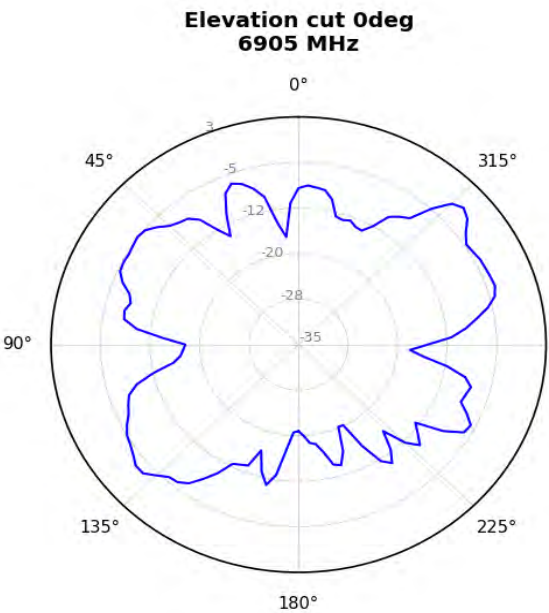
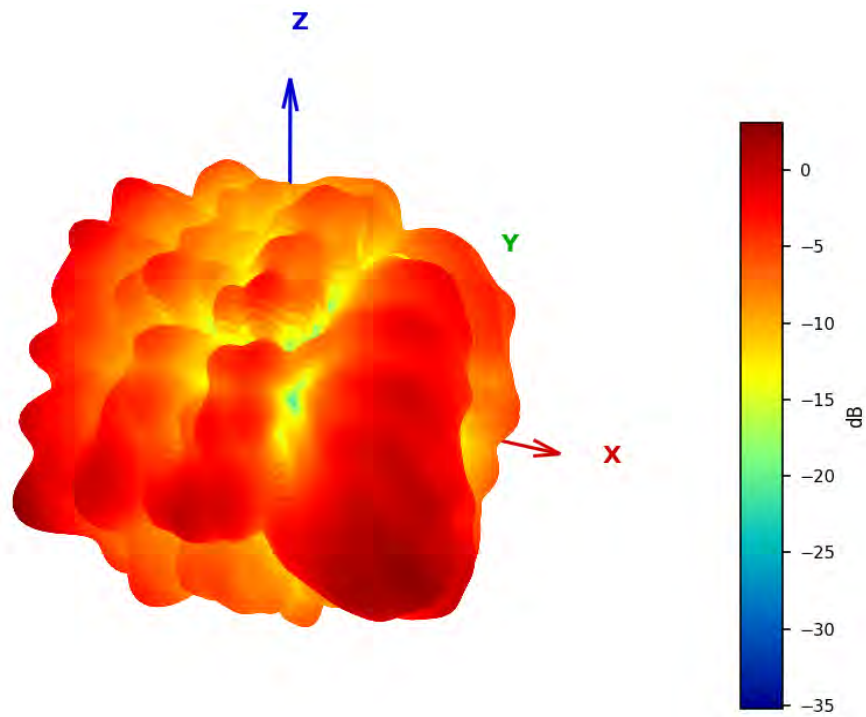
3D Radiation Pattern | 6855 MHz | Peak Gain: 4.64 dBi



3D Radiation Pattern (ETotal)

WiFi | Ant. 2 | U-NII-8 (6875-7125 MHz)

3D Radiation Pattern | 6905 MHz | Peak Gain: 3.89 dBi



3D Radiation Pattern (ETotal)