

Antenna Report

FCC ID: A4RG0DZQ

11/17/2022

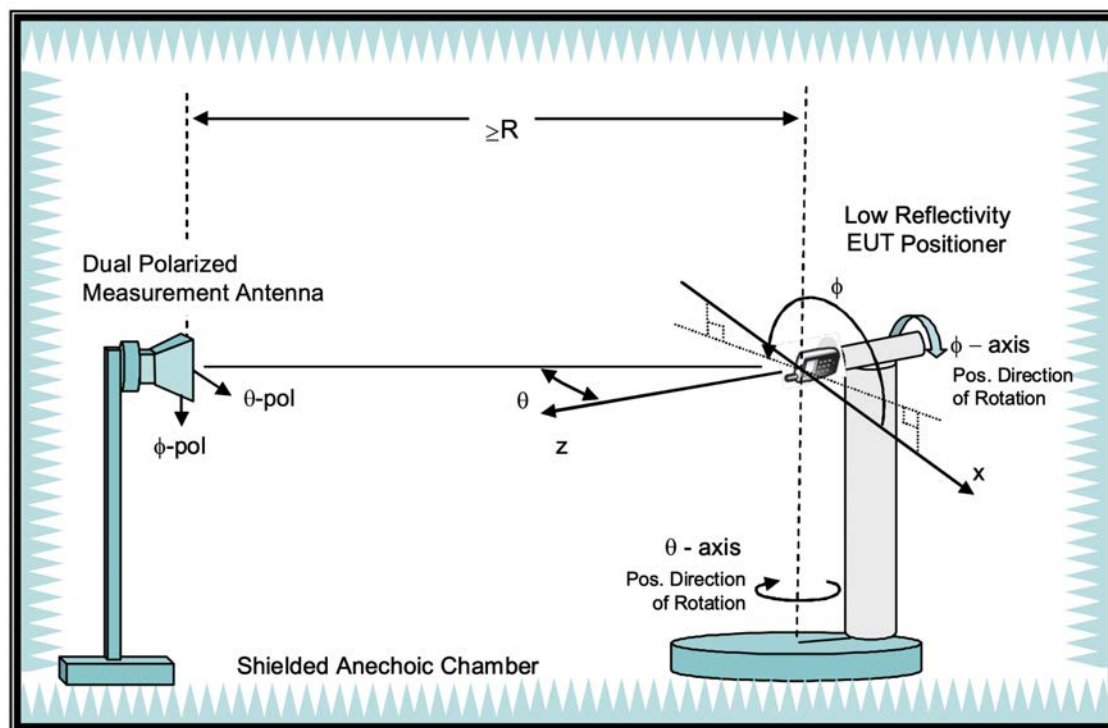
Google LLC

1. Test Method

The antenna gains are obtained through measurements in a fully anechoic OTA chamber with a 3D positioner.

Measurements are taken in discrete steps in theta and phi direction, data is being recorded using a network analyzer (passive) for both theta and phi polarizations at each position resulting in a 3D gain pattern. Step size is <30deg along both axes.

Gain is derived directly through spatial averaging of VNA S21 measurements (passive measurement).



R=4.9m

2. Test Equipment

Site Description	Chamber Manufacturer	Type
Great-circle	WAVEPRO	Fully Anechoic
Software Version	g.OTA Ver:1.0.80	
Site location:	9F, No. 6-3, Baoqiang Rd., Xindian Dist., New Taipei City	
Test Engineer	Mike Lee / Jack Lu	
Date	Aug. 23, 2022	

Description	Manufacturer	Model	Calibration Date	Due Date
Network Analyzer	Agilent	E5071C	Feb. 17, 2022	Feb. 17, 2023
Spectrum Analyze	Rohde & Schwarz	FSV7	Sep. 21, 2021	Sep 21, 2023

3. Test Setup

See separate appendix document for pictures of the test setup in this filing.

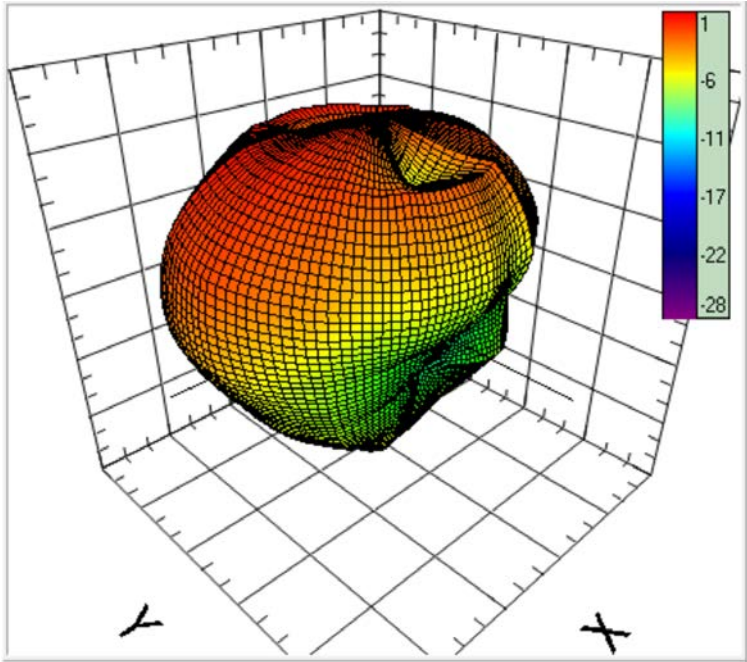
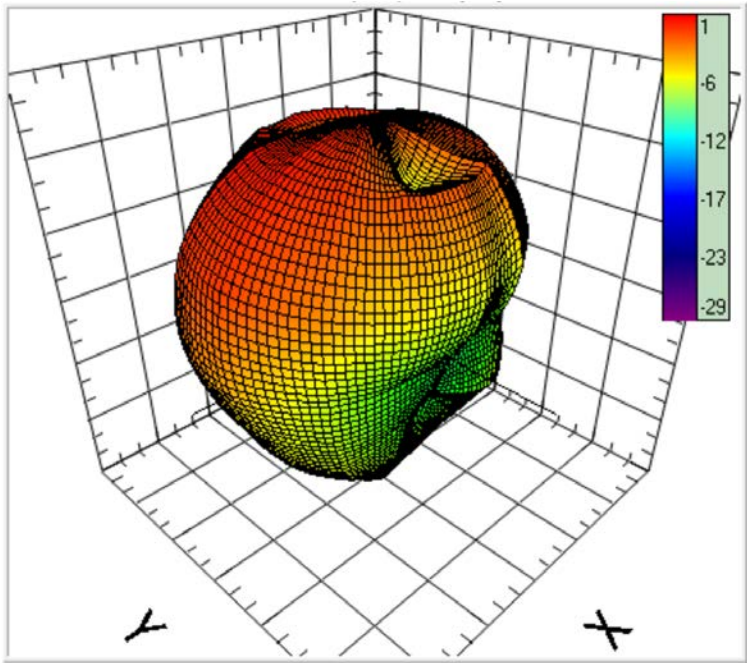
4. Antenna Type

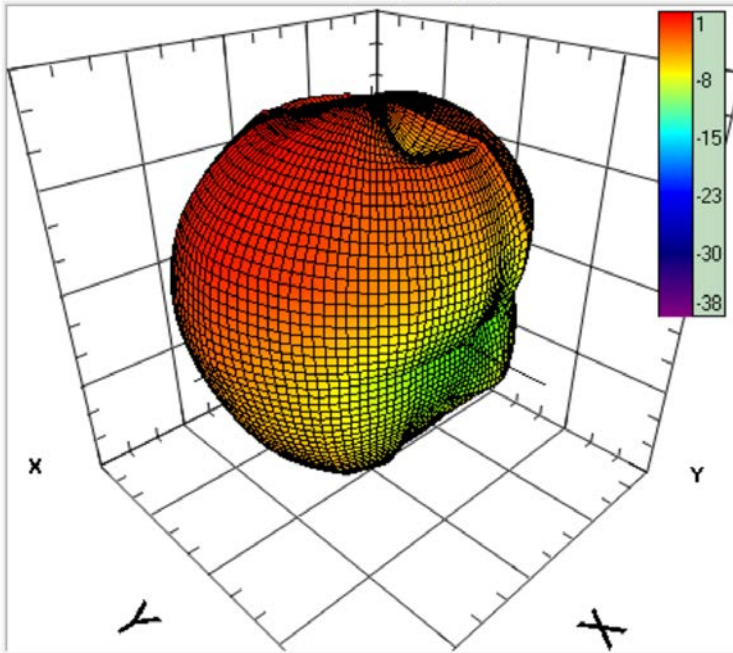
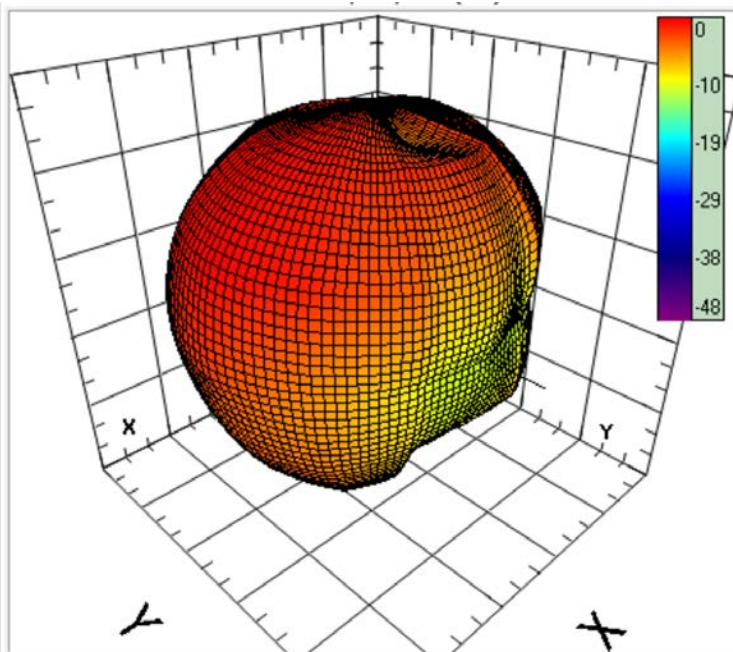
Antenna	Type
Ant3	IFA
Ant4	ILA

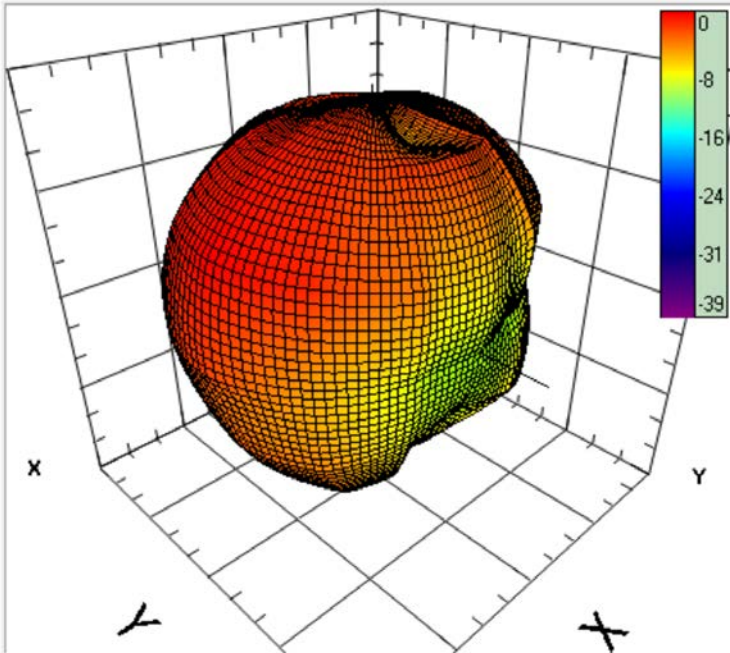
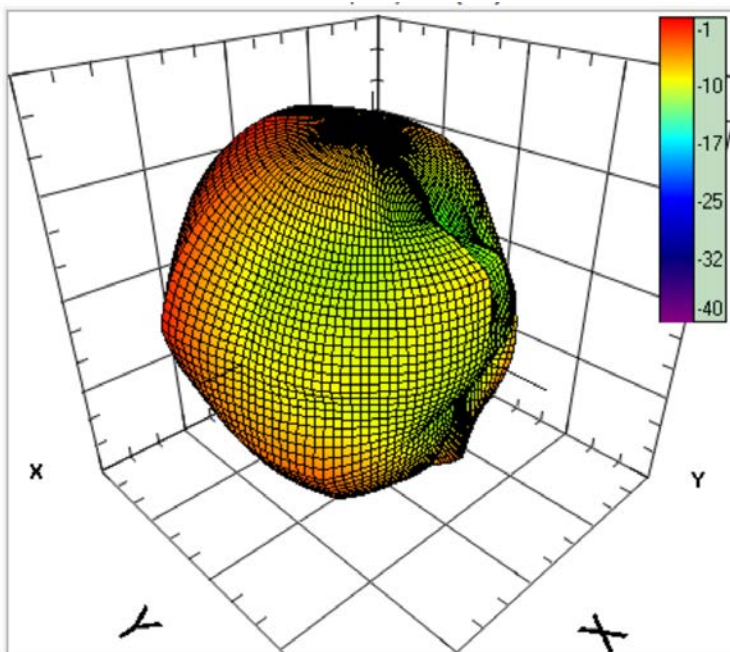
5. WLAN/BT Antenna Test Data

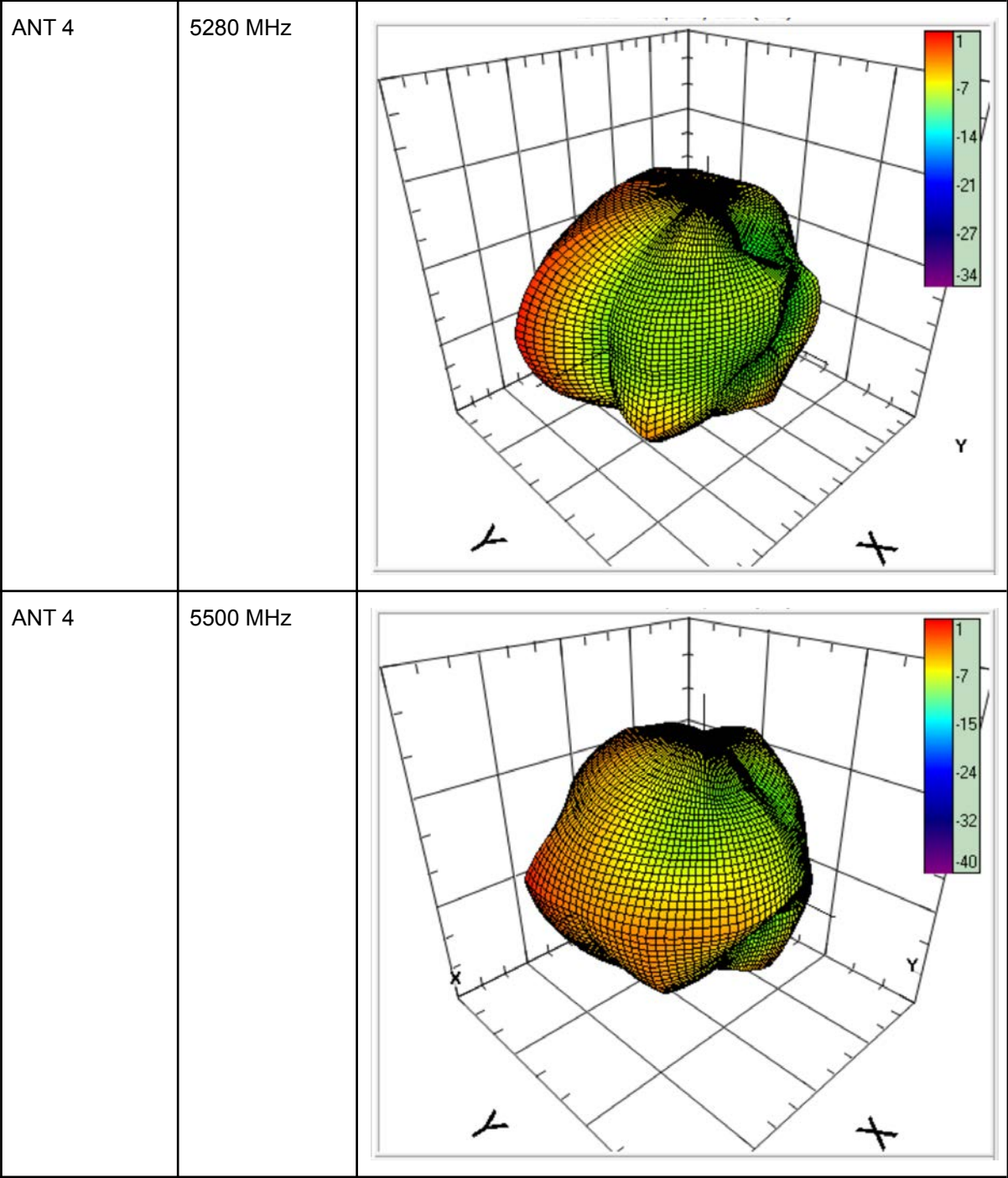
Ant	Band	Frequency Band	Peak Gain(dBi)
Ant 4	WiFi/BT 2.4 GHz	2402 MHz	-0.7
		2412 MHz	-0.7
		2437 MHz	-1.0
		2462 MHz	-1.7
		2480 MHz	-1.9
Ant 3	WiFi/BT 2.4 GHz	2402 MHz	0.6
		2412 MHz	0.8
		2437 MHz	0.6
		2462 MHz	0.5
		2480 MHz	0.2
Ant 4	UNII-1	5180 MHz	-3.1
	UNII-2A	5280 MHz	-0.8
	UNII-2C	5500 MHz	0.9
	UNII-3	5820 MHz	0.4
	UNII-4	5887 MHz	0.3
	UNII-5	6175 MHz	0.3
	UNII-6	6475 MHz	-3.6
	UNII-7	6700 MHz	-2.7
	UNII-8	7000 MHz	-3.5
Ant 3	UNII-1	5180 MHz	-3.3
	UNII-2A	5280 MHz	-3.0
	UNII-2C	5500 MHz	-1.1
	UNII-3	5820 MHz	-0.7
	UNII-4	5887 MHz	-0.4
	UNII-5	6175 MHz	0.3
	UNII-6	6475 MHz	2.4
	UNII-7	6700 MHz	2.5
	UNII-8	7000 MHz	-0.3

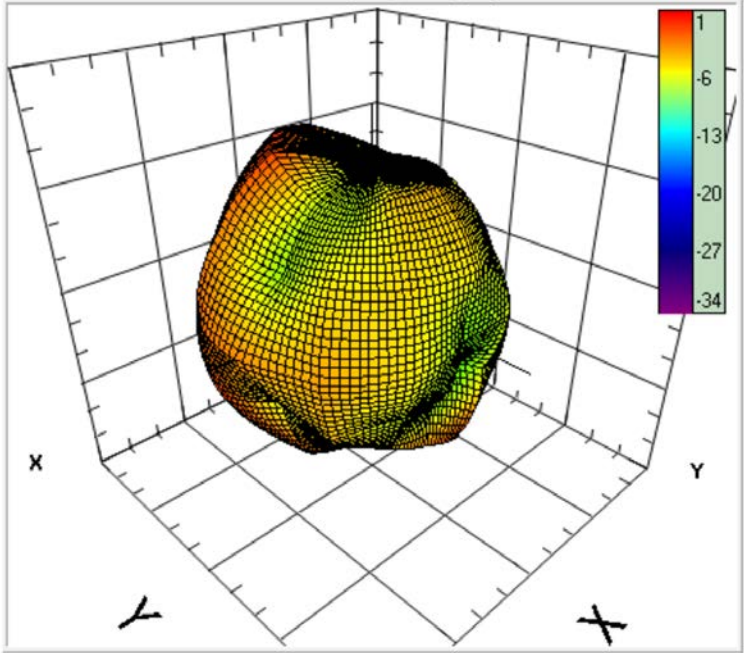
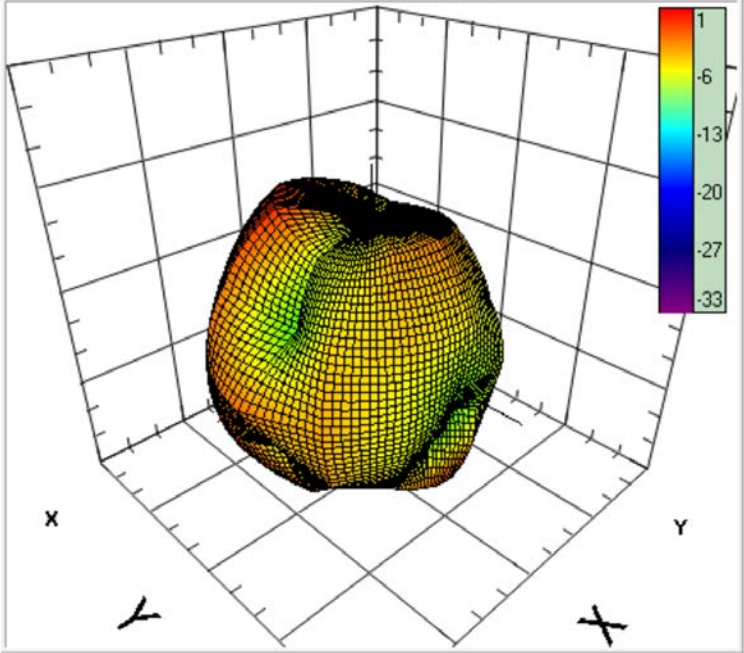
6. Radiation Plots for Max Gain Plane

ANT	Frequency	Pattern
ANT 4	2402 MHz	
ANT 4	2412 MHz	

ANT 4	2437 MHz	 A 3D surface plot of a sphere, rendered with a grid mesh. The sphere is colored according to a scale ranging from 1 (red) to -38 (purple). The plot is shown in a 3D coordinate system with axes labeled X, Y, and Z. The Z-axis is vertical, X is horizontal to the left, and Y is horizontal to the right. The color scale is indicated by a vertical bar on the right side of the plot, with values 1, -8, -15, -23, -30, and -38.
ANT 4	2462 MHz	 A 3D surface plot of a sphere, rendered with a grid mesh. The sphere is colored according to a scale ranging from 0 (red) to -48 (purple). The plot is shown in a 3D coordinate system with axes labeled X, Y, and Z. The Z-axis is vertical, X is horizontal to the left, and Y is horizontal to the right. The color scale is indicated by a vertical bar on the right side of the plot, with values 0, -10, -19, -29, -38, and -48.

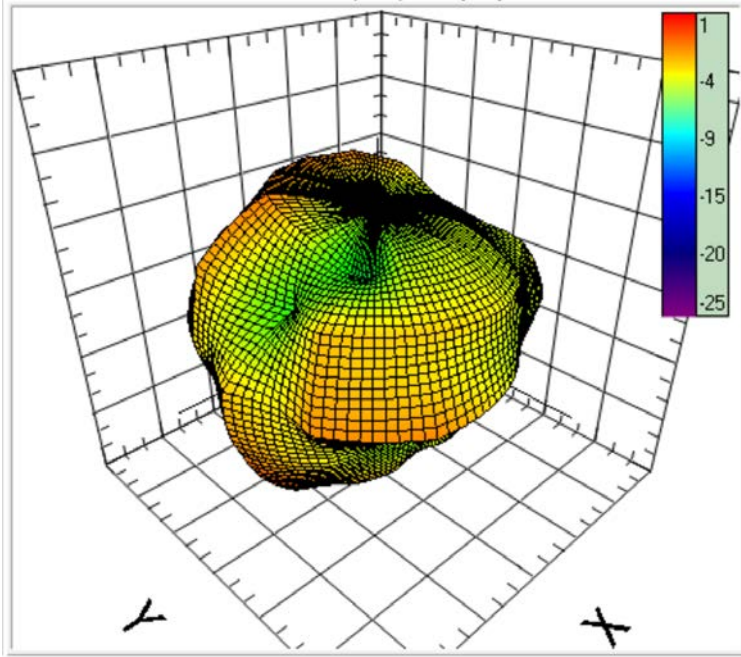
ANT 4	2480 MHz	 A 3D radiation pattern plot for ANT 4 at 2480 MHz. The plot shows a spherical shape with a color scale from 0 (red) to -39 (purple). The axes are labeled X, Y, and Z. The color scale is as follows: <table><tr><th>Color</th><th>Value</th></tr><tr><td>Red</td><td>0</td></tr><tr><td>Orange</td><td>-8</td></tr><tr><td>Yellow</td><td>-16</td></tr><tr><td>Green</td><td>-24</td></tr><tr><td>Blue</td><td>-31</td></tr><tr><td>Purple</td><td>-39</td></tr></table>	Color	Value	Red	0	Orange	-8	Yellow	-16	Green	-24	Blue	-31	Purple	-39
Color	Value															
Red	0															
Orange	-8															
Yellow	-16															
Green	-24															
Blue	-31															
Purple	-39															
ANT 4	5180 MHz	 A 3D radiation pattern plot for ANT 4 at 5180 MHz. The plot shows a spherical shape with a color scale from -1 (red) to -40 (purple). The axes are labeled X, Y, and Z. The color scale is as follows: <table><tr><th>Color</th><th>Value</th></tr><tr><td>Red</td><td>-1</td></tr><tr><td>Orange</td><td>-10</td></tr><tr><td>Yellow</td><td>-17</td></tr><tr><td>Green</td><td>-25</td></tr><tr><td>Blue</td><td>-32</td></tr><tr><td>Purple</td><td>-40</td></tr></table>	Color	Value	Red	-1	Orange	-10	Yellow	-17	Green	-25	Blue	-32	Purple	-40
Color	Value															
Red	-1															
Orange	-10															
Yellow	-17															
Green	-25															
Blue	-32															
Purple	-40															



ANT 4	5820 MHz	 A 3D radiation pattern plot for ANT 4 at 5820 MHz. The plot shows a main lobe with a color scale from 1 to -34 dB. The x, y, and z axes are labeled. The color scale ranges from 1 (red) to -34 (purple).
ANT 4	5887 MHz	 A 3D radiation pattern plot for ANT 4 at 5887 MHz. The plot shows a main lobe with a color scale from 1 to -33 dB. The x, y, and z axes are labeled. The color scale ranges from 1 (red) to -33 (purple).

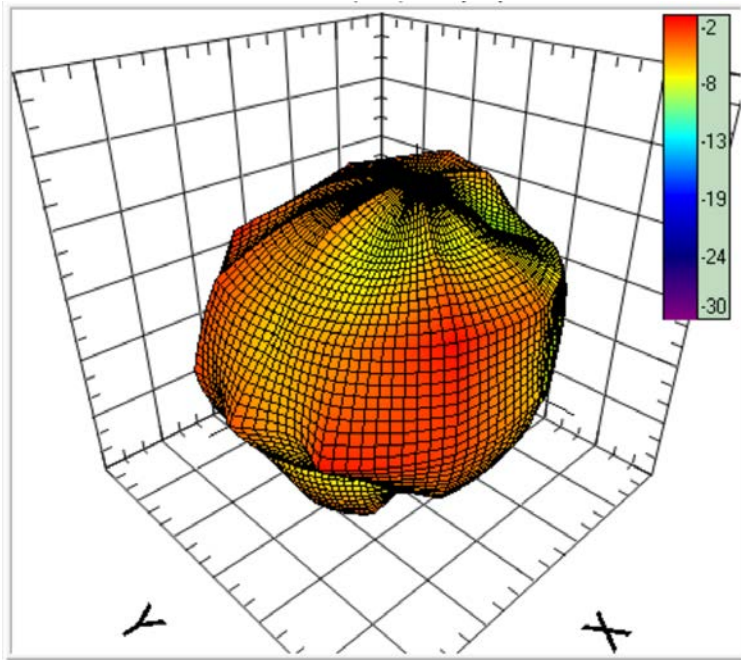
ANT 4

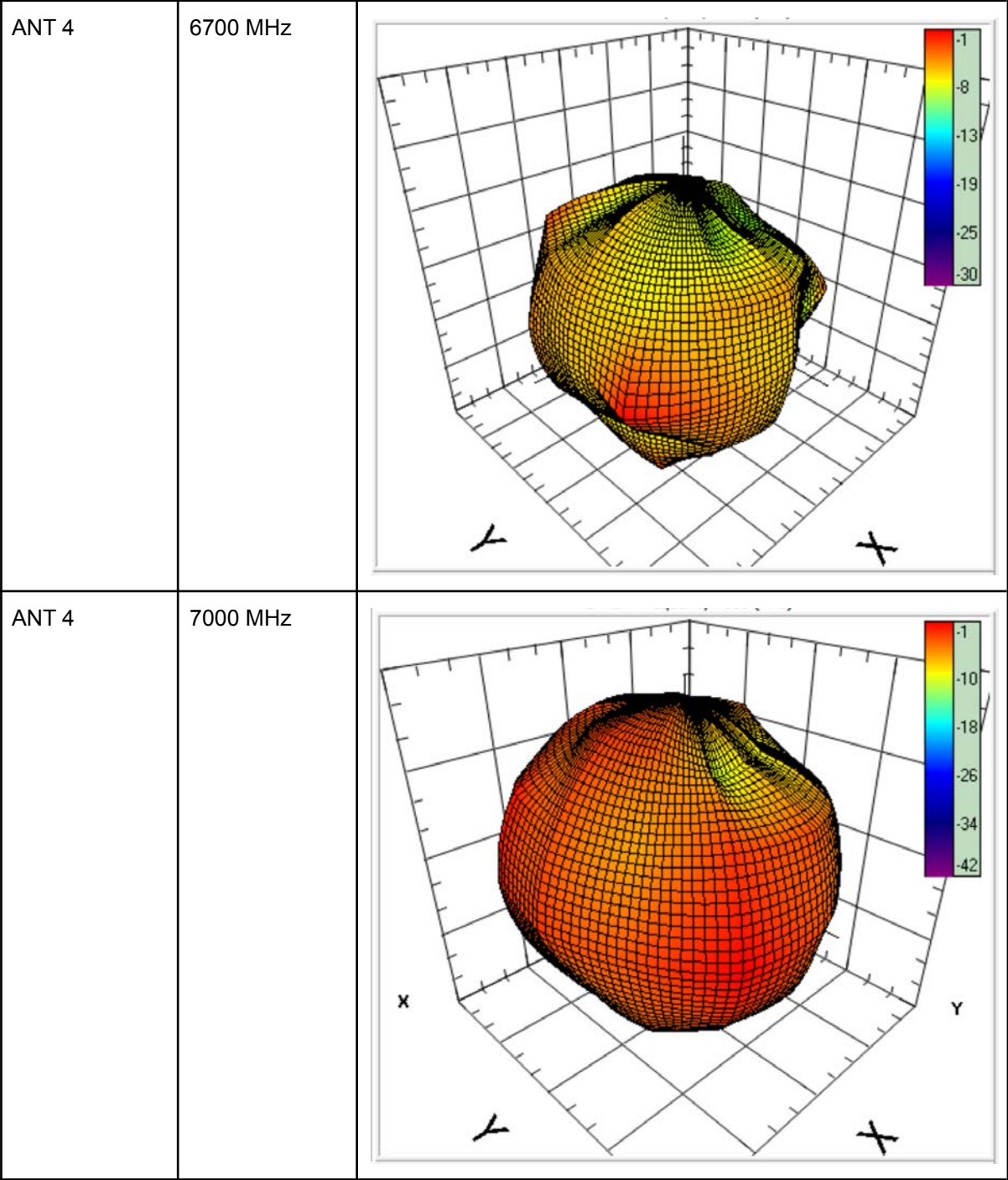
6175 MHz

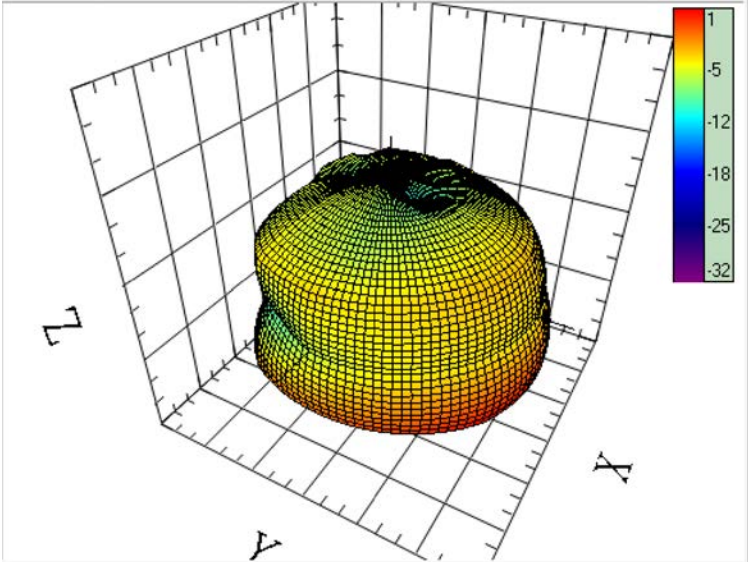
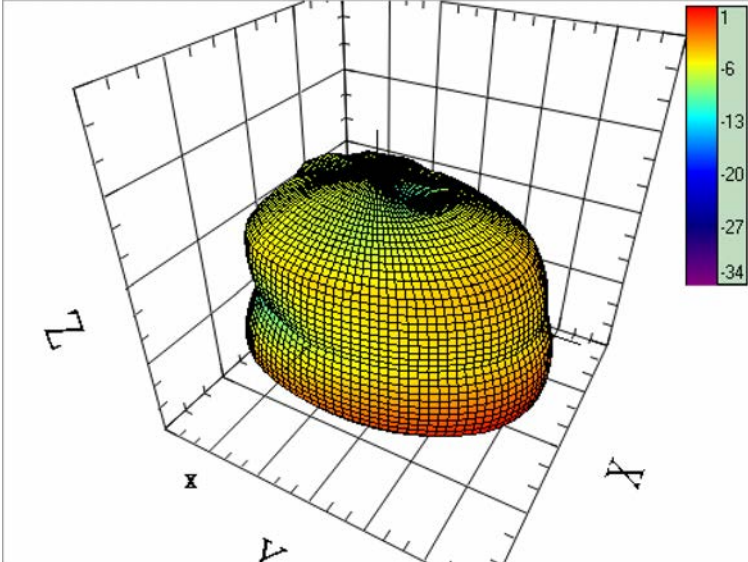
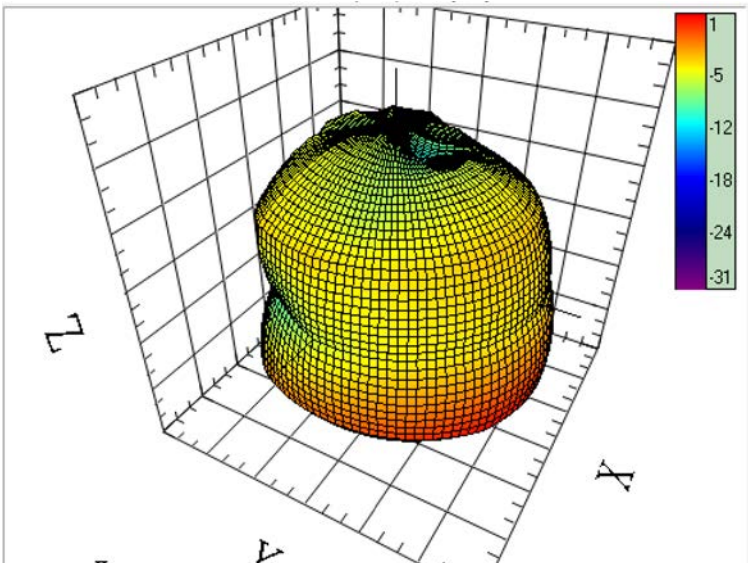


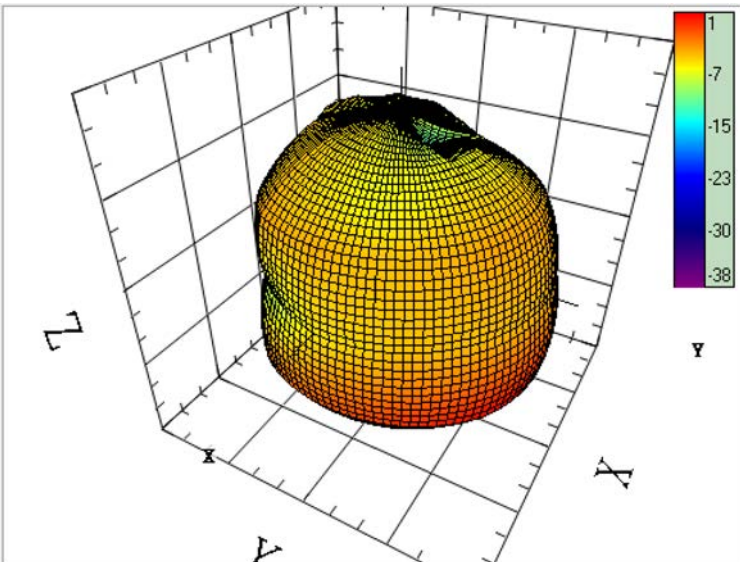
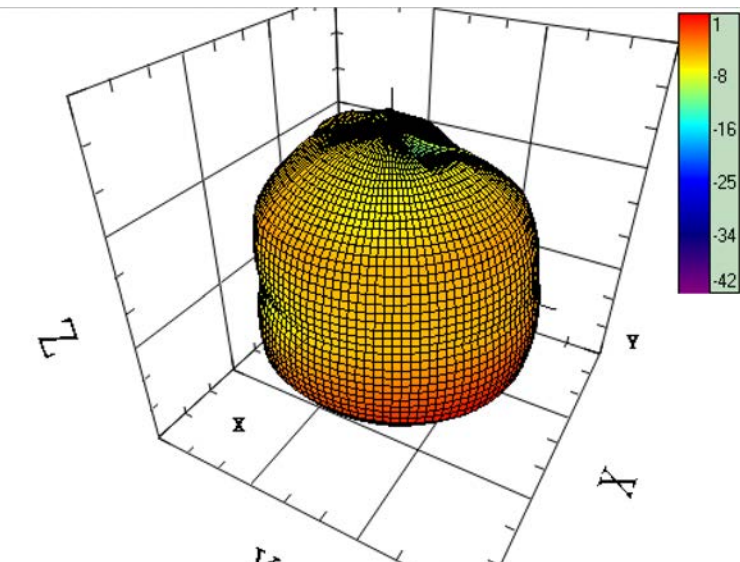
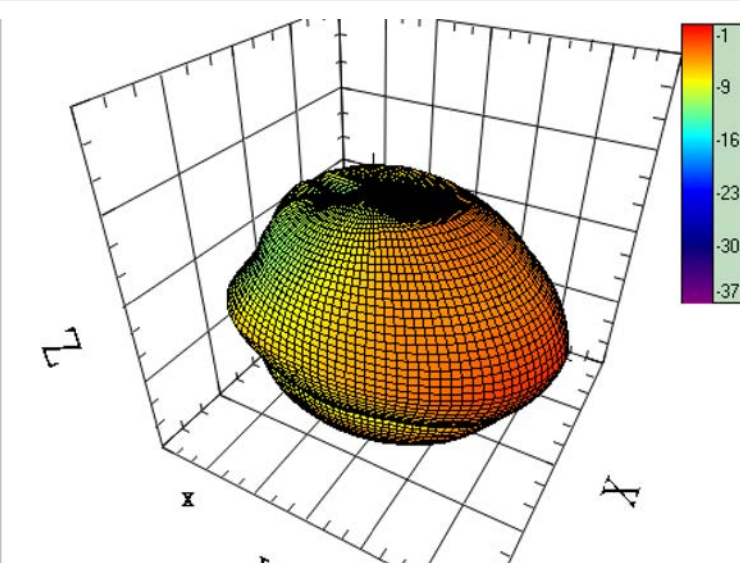
ANT 4

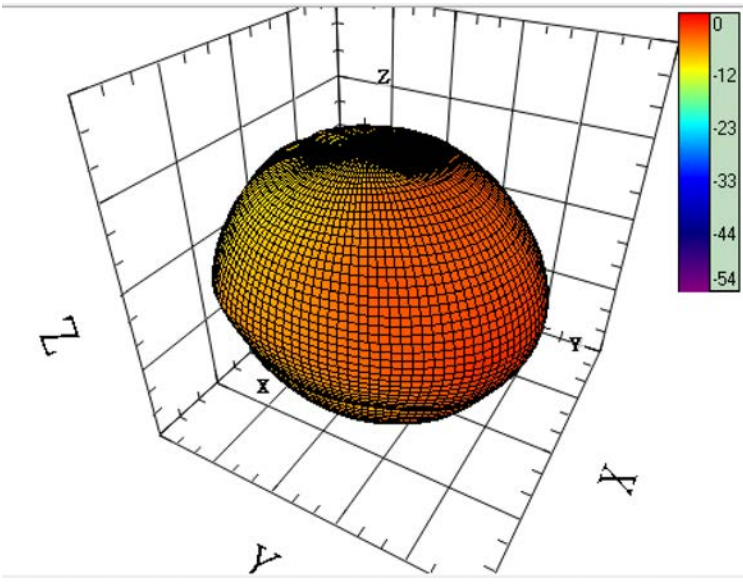
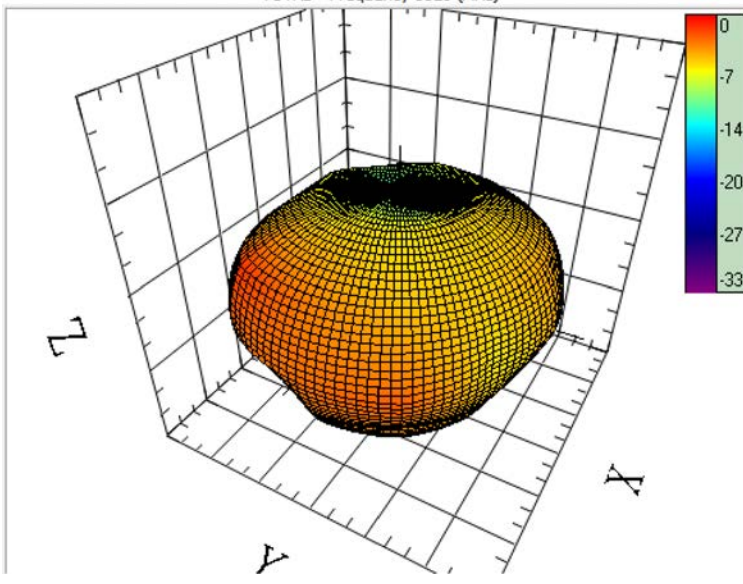
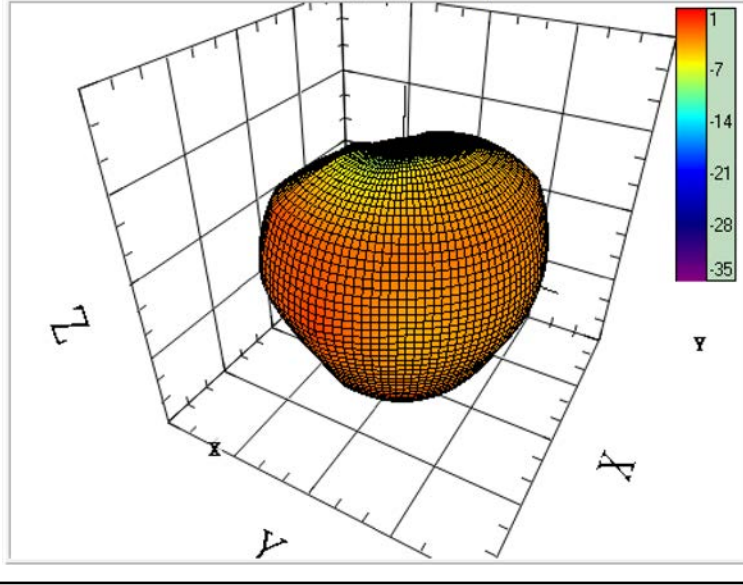
6475 MHz

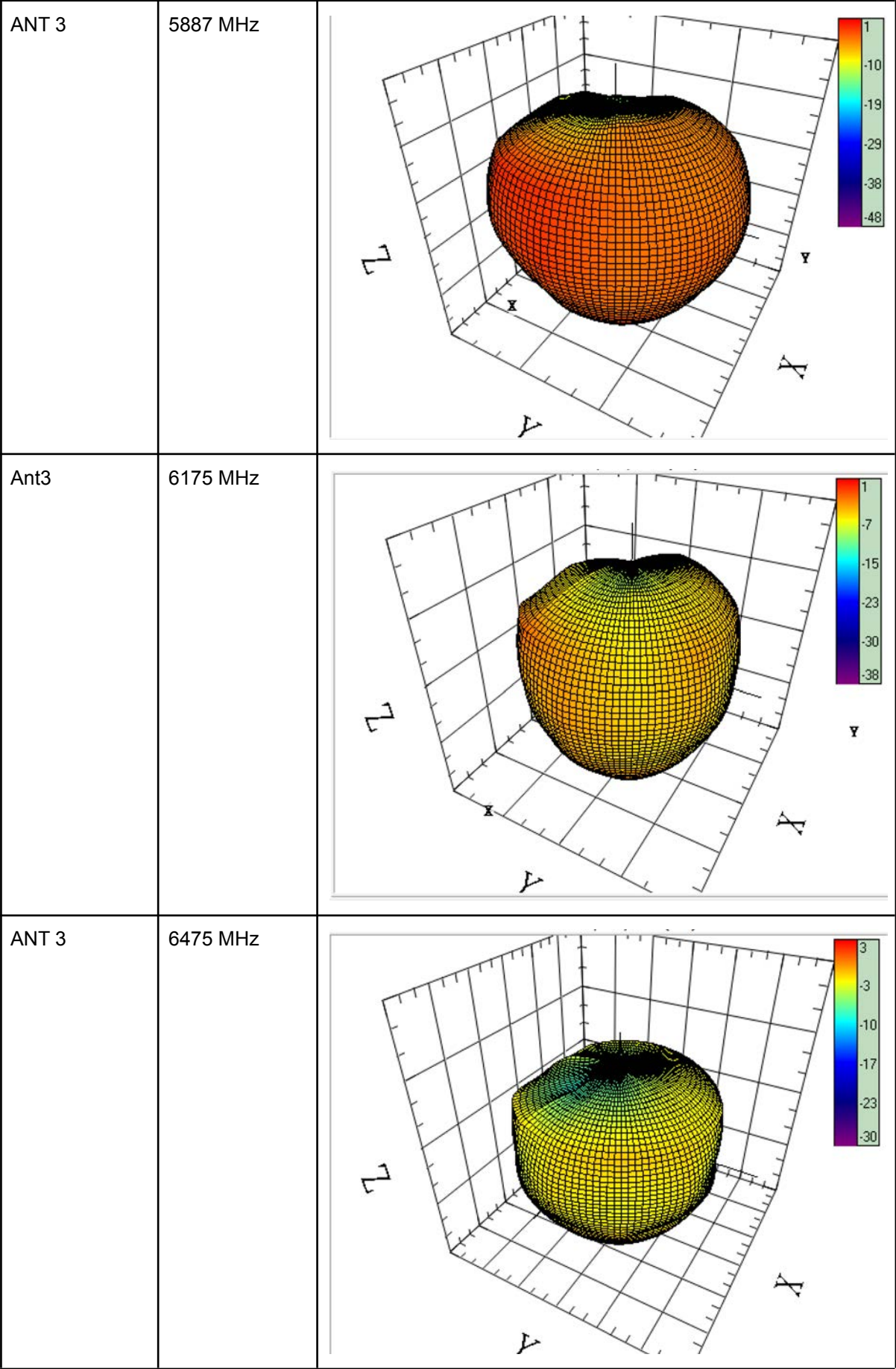




ANT 3	2402 MHz	 A 3D surface plot of an orange, rendered as a wireframe mesh, positioned within a 3D coordinate system with axes labeled X, Y, and Z. The surface is color-coded according to a vertical color bar on the right, which ranges from 1 (red) at the top to -32 (purple) at the bottom, with intermediate values at -5, -12, -18, and -25. The orange is oriented with its stem at the top, and the color gradient is most pronounced on the right side of the fruit.
ANT 3	2412 MHz	 A 3D surface plot of an orange, rendered as a wireframe mesh, positioned within a 3D coordinate system with axes labeled X, Y, and Z. The surface is color-coded according to a vertical color bar on the right, which ranges from 1 (red) at the top to -34 (purple) at the bottom, with intermediate values at -6, -13, -20, and -27. The orange is oriented with its stem at the top, and the color gradient is most pronounced on the right side of the fruit.
ANT 3	2437 MHz	 A 3D surface plot of an orange, rendered as a wireframe mesh, positioned within a 3D coordinate system with axes labeled X, Y, and Z. The surface is color-coded according to a vertical color bar on the right, which ranges from 1 (red) at the top to -31 (purple) at the bottom, with intermediate values at -5, -12, -18, and -24. The orange is oriented with its stem at the top, and the color gradient is most pronounced on the right side of the fruit.

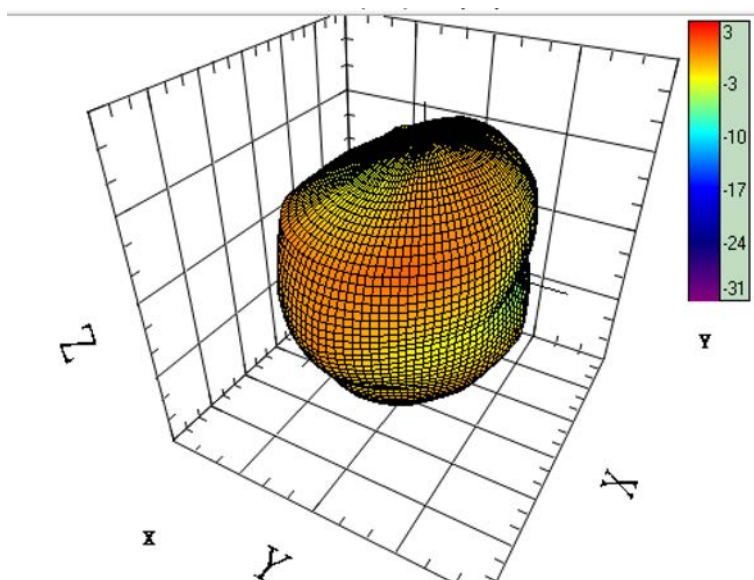
ANT 3	2462 MHz	 A 3D surface plot of an orange, rendered with a wireframe mesh. The orange is positioned in a 3D coordinate system with axes labeled X, Y, and Z. The surface is colored according to a scale ranging from 1 (yellow) to -38 (purple). The orange is centered in the plot, and the axes are labeled with their respective directions.
ANT 3	2480 MHz	 A 3D surface plot of an orange, rendered with a wireframe mesh. The orange is positioned in a 3D coordinate system with axes labeled X, Y, and Z. The surface is colored according to a scale ranging from 1 (yellow) to -42 (purple). The orange is centered in the plot, and the axes are labeled with their respective directions.
ANT 3	5180 MHz	 A 3D surface plot of an orange, rendered with a wireframe mesh. The orange is positioned in a 3D coordinate system with axes labeled X, Y, and Z. The surface is colored according to a scale ranging from 1 (yellow) to -37 (purple). The orange is centered in the plot, and the axes are labeled with their respective directions.

Ant 3	5280 MHz	
ANT 3	5500 MHz	
Ant 3	5820 MHz	



ANT 3

6700 MHz



ANT 3

7000 MHz

