Antenna Report

FCC ID: A4RG6GPR

10/30/2023

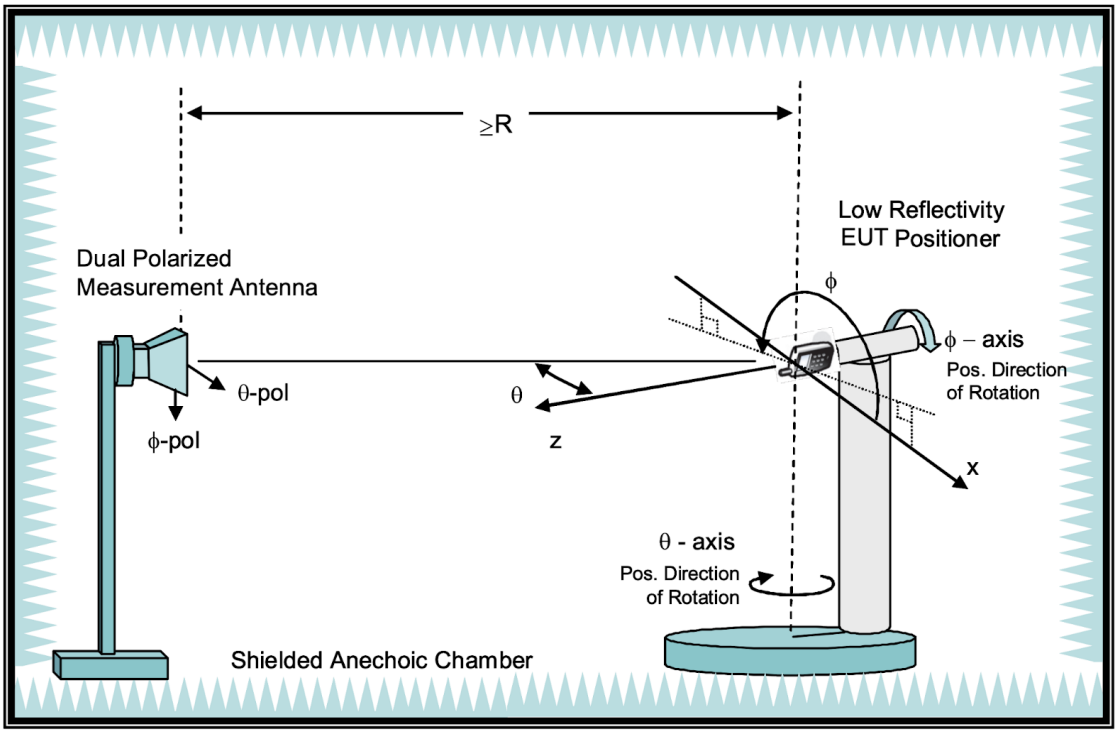
Google LLC

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 <30 deg 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 / Jeffrey Yang	
Test Date	August 2023	

Description	Manufacturer	Model	Calibration Date	Due Date
Network Analyzer	Agilent	E5071C	Jun. 30, 2023	Jun. 30, 2025
Spectrum Analyze	Rohde & Schwarz	FSV7	Sep. 21, 2021	Sep 21, 2023

3. Site Path Loss

To provide accurate antenna gain values, the chamber is calibrated with the measured path loss. The block diagram below represents the setup of the site path loss. Path loss is provided for both polarities for all WLAN frequency ranges.

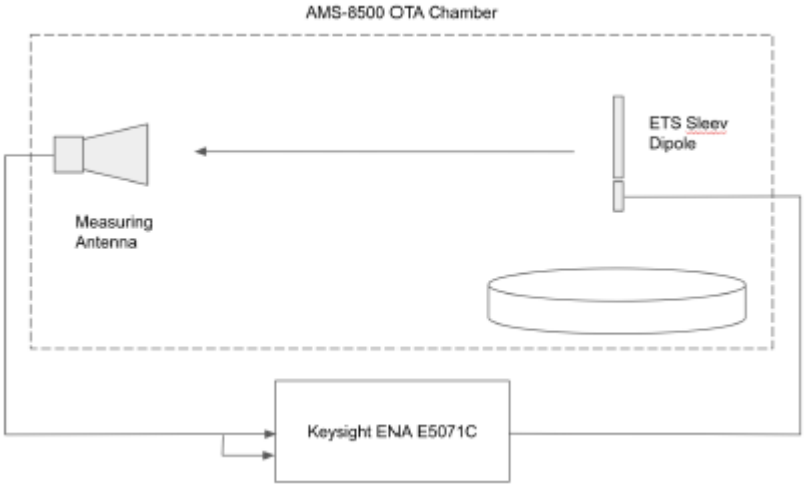


Figure: Block Diagram of Path Loss

Frequency (MHz)	H-Pol Path Loss	V-Pol Path Loss
2402	-35.5	-35.26
2412	-35.59	-35.32
2437	-35.95	-35.53
2462	-35.98	-35.63
2480	-36.09	-35.76
5150	-46.74	-47.14
5230	-43.05	-43.76
5250	-42.82	-43.23
5310	-42.49	-42.77
5340	-42.23	-42.9
5480	-42.14	-42.84
5530	-42.23	-43.28
5710	-42.68	-43.9
5795	-42.6	-43.43
5835	-42.46	-43.35
5855	-42.75	-43.9
5875	-43	-44.33
5925	-42.92	-44.45
6175	-47.48	-47.91
6425	-46.37	-45.79
6525	-45.67	-46.07
6875	-49.77	-46.85
7085	-47.62	-46.06

4. Test Setup

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

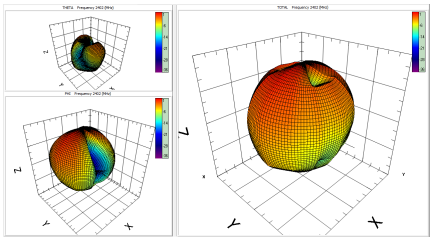
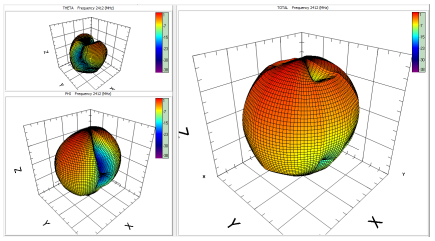
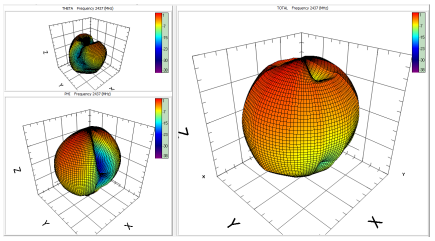
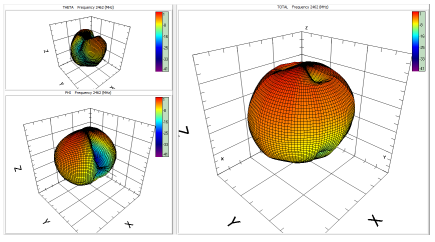
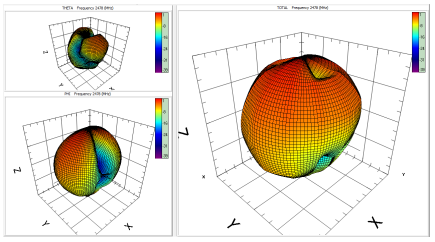
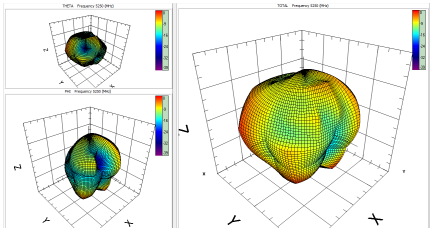
5. Antenna Type

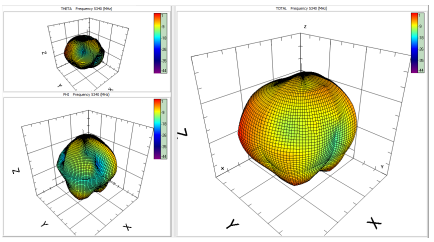
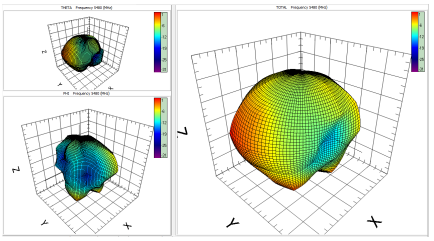
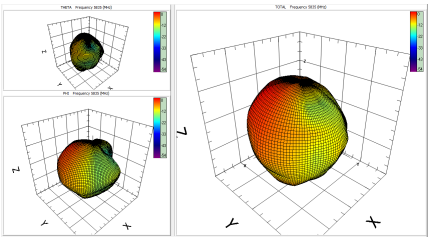
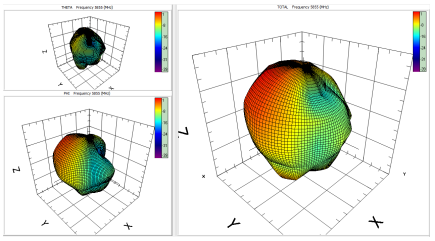
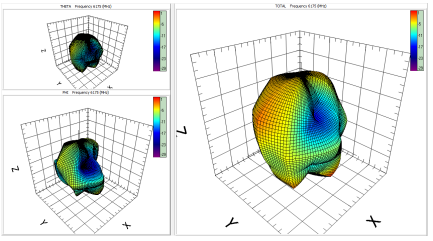
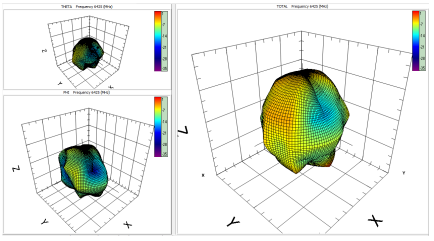
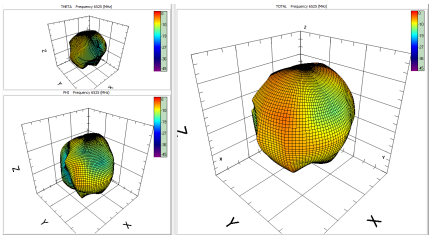
Antenna	Type
Ant 3	IFA
Ant 4	ILA

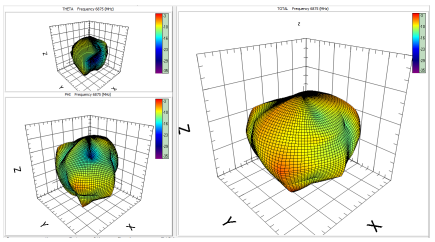
6. WLAN/BT Antenna Test Data

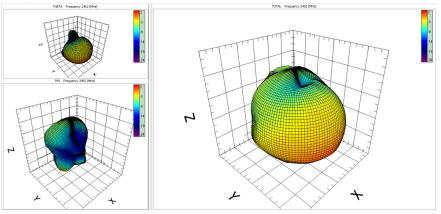
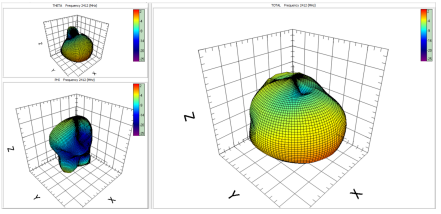
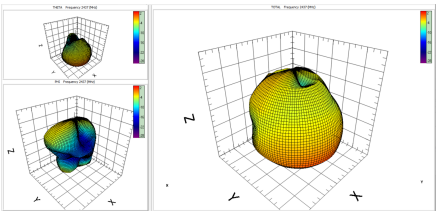
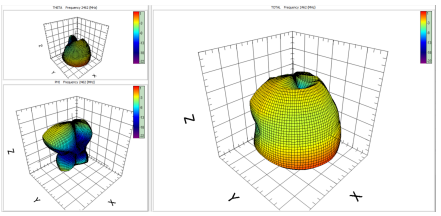
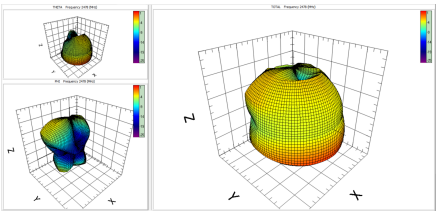
Ant	Band	Frequency Band	Peak Gain(dBi)
Ant 4	WiFi/BT 2.4 GHz	2402 MHz	-0.7
		2412 MHz	-0.8
		2437 MHz	-0.9
		2462 MHz	-1.3
		2480 MHz	-1.3
Ant 3	WiFi/BT 2.4 GHz	2402 MHz	-1.3
		2412 MHz	-1.4
		2437 MHz	-1.4
		2462 MHz	-1.4
		2480 MHz	-1.2
Ant 4	UNII-1	5180 MHz	-3.6
	UNII-2A	5280 MHz	-3.3
	UNII-2C	5500 MHz	-2.9
	UNII-3	5820 MHz	-3.7
	UNII-4	5887 MHz	-3.3
	UNII-5	6175 MHz	-2.7
	UNII-6	6475 MHz	-3.9
	UNII-7	6700 MHz	-4.1
	UNII-8	7000 MHz	-5.9
Ant 3	UNII-1	5150 MHz	-3.4
	UNII-2A	5310 MHz	-3.5
	UNII-2C	5710 MHz	-3.0
	UNII-3	5795 MHz	-3.1
	UNII-4	5875 MHz	-3.3
	UNII-5	6425 MHz	-3.8
	UNII-6	6525 MHz	-4.4
	UNII-7	6670 MHz	-4.1
	UNII-8	6875 MHz	-4.5

7. Radiation Plots for Max Gain Plane

ANT 4	2402 MHz	
ANT 4	2412 MHz	
ANT 4	2437 MHz	
ANT 4	2462 MHz	
ANT 4	2480 MHz	
ANT 4	5250 MHz	

ANT 4	5340 MHz	
ANT 4	5480 MHz	
ANT 4	5835 MHz	
ANT 4	5855 MHz	
ANT 4	6175 MHz	
ANT 4	6425 MHz	
ANT 4	6525 MHz	

ANT 4	6875 MHz	

ANT 3	2402 MHz	
ANT 3	2412 MHz	
ANT 3	2437 MHz	
ANT 3	2462 MHz	
ANT 3	2480 MHz	
ANT 3	5150 MHz