Antenna Report

FCC ID: A4RGUL82, A4RG45RY

Date: April 16, 2025

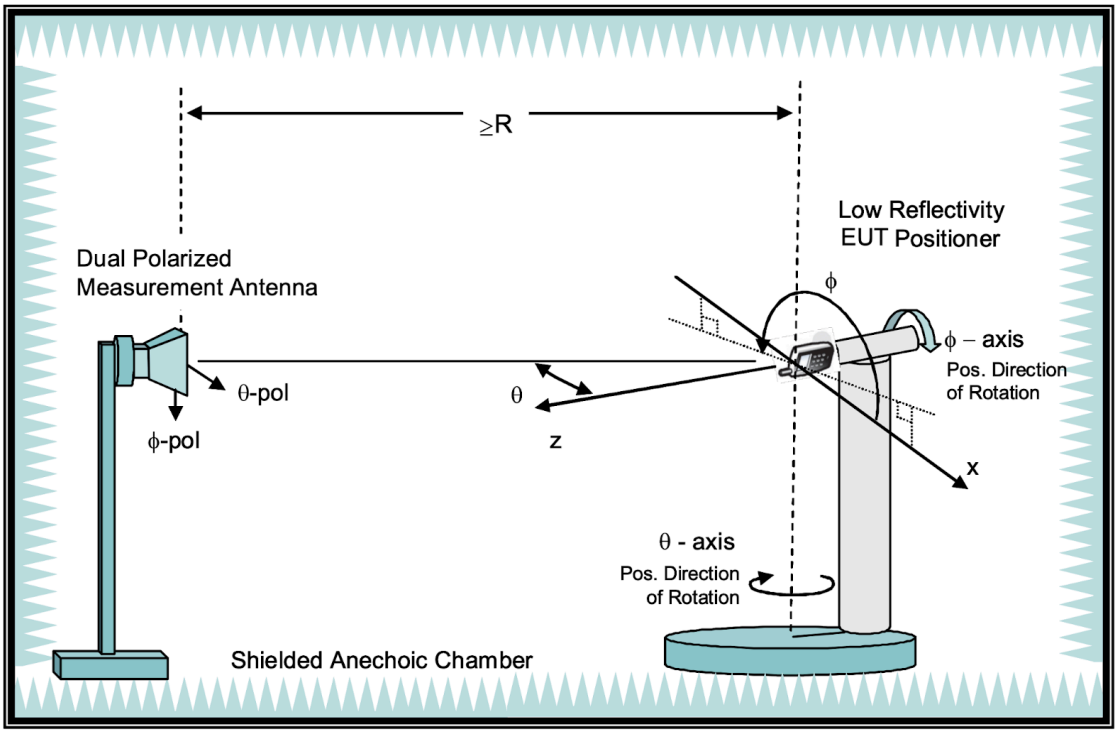
Google LLC

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

Test Chamber Information			
Chamber Manufacturer	**Type**	**Software Version**	**Chamber Location**
ETS	Great-circle Fully Anechoic	EMQuest 1.08 Build 142267	No.4, Mingsheng st.,Tucheng City, New Taipei City 23678, Taiwan(R.O.C)

Test Equipment Information				
Instrument	**Manufacturer**	**Model**	**Calibration Date**	**Due Date**
Network Analyzer	Keysight	E5071C	01/02/2024	05/10/2025

Reviewed by: Zhisen Qian
Review Completion Date: 04/01/2025

Test Engineer: Jim Tsai
Test Completion Date: 02/05/2025

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.

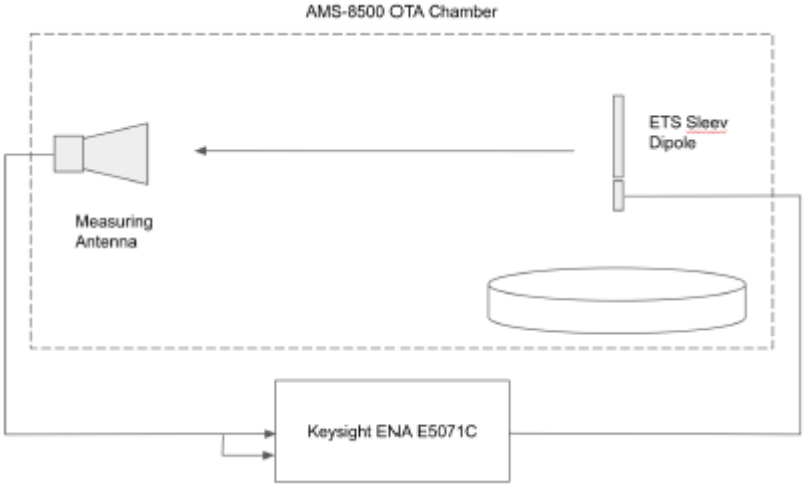


Figure: Block Diagram of Path Loss

Frequency (MHz)	H-Pol Path Loss	V-Pol Path Loss
2402	-72.9225	-73.6704
2412	-73.2254	-73.8614
2437	-73.7982	-74.2182
2462	-74.0277	-74.2138
2480	-73.8388	-73.8788
5150	-85.5354	-84.528
5230	-85.2049	-84.4272
5250	-85.6958	-84.9565
5310	-85.4112	-85.0645
5340	-85.1642	-85.1128
5480	-86.138	-85.6816
5530	-85.9573	-85.2082
5710	-85.7304	-84.927
5795	-86.1262	-85.2813
5835	-86.469	-85.5827
5855	-86.2959	-85.3446

5875	-86.4701	-85.4787
5925	-86.8649	-85.6704
6175	-87.3352	-86.3128
6425	-89.2761	-88.4633
6525	-88.5347	-87.94
6875	-89.975	-89.0825
7085	-90.252	-90.1347

4. Test Setup

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

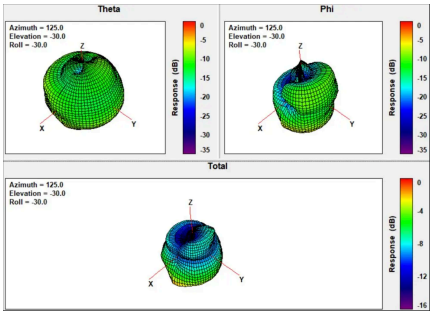
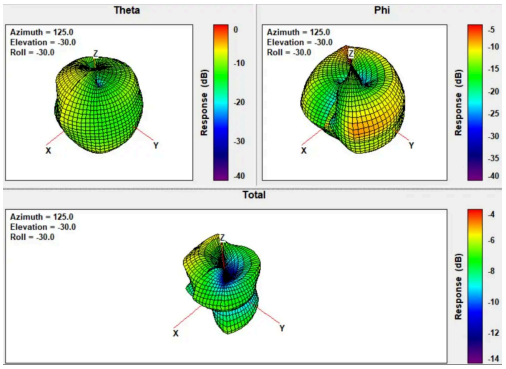
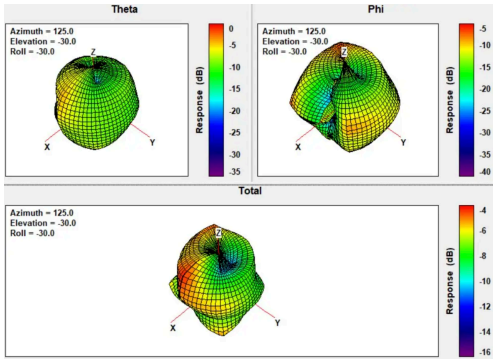
5. **Antenna Type**

Antenna	Type
Ant 3	IFA
Ant 4	ILA

6. WLAN/BT Antenna Test Data

Ant	Band	Frequency	Peak Gain(dBi)
Ant 4	WiFi/BT 2.4 GHz	2402 - 2480 MHz	-1.1
Ant 3	WiFi/BT 2.4 GHz	2402 - 2480 MHz	-0.1
Ant 4	UNII-1	5180 MHz	-5.6
	UNII-2A	5280 MHz	-4.1
	UNII-2C	5500 MHz	-4.7
	UNII-3	5820 MHz	-7.0
	UNII-4	5887 MHz	-5.6
	UNII-5	6175 MHz	-5.8
	UNII-6	6475 MHz	-7.1
	UNII-7	6700 MHz	-7.2
	UNII-8	7000 MHz	-5.4
Ant 3	UNII-1	5180 MHz	-2.3
	UNII-2A	5280 MHz	-2.5
	UNII-2C	5500 MHz	-4.6
	UNII-3	5820 MHz	-5.1
	UNII-4	5887 MHz	-4.8
	UNII-5	6175 MHz	-2.7
	UNII-6	6475 MHz	-2.9
	UNII-7	6700 MHz	-1.4
	UNII-8	7000 MHz	-3.5

7. Radiation Plots for Max Gain Plane

ANT	Frequency	Pattern
ANT 4	2402 - 2480 MHz	
ANT 4	5180 MHz	
ANT 4	5280 MHz	
ANT 4	5500 MHz