

# Antenna Report

FCC ID: A4RGTF7P

Sep. 30 , 2024

Google LLC

A handwritten signature in grey ink that reads "Mark Chung". The signature is written in a cursive, flowing style.

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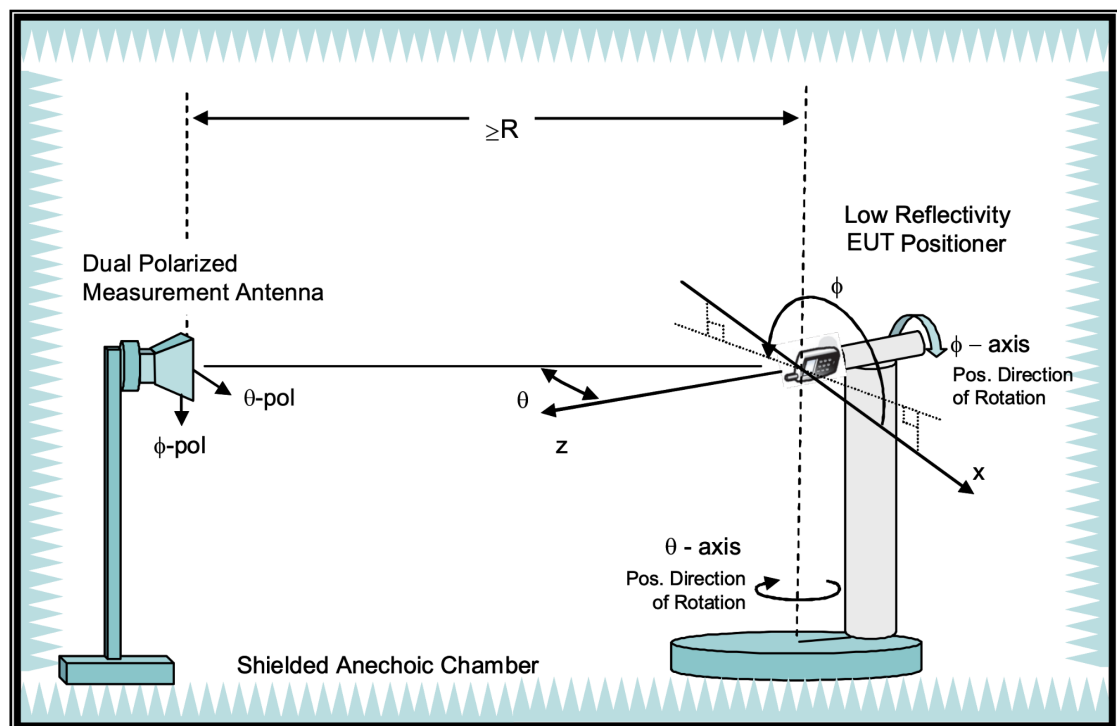
Review by: Mark Chung

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 |                |
| Prepare by       | Rich Liu / Annie Chen                                     |                |
| Test Date        | September 2024                                            |                |

| Description      | Manufacturer | Model  | Calibration Date | Due Date      |
|------------------|--------------|--------|------------------|---------------|
| Network Analyzer | Agilent      | E5071C | Jun. 30, 2023    | Jun. 30, 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.

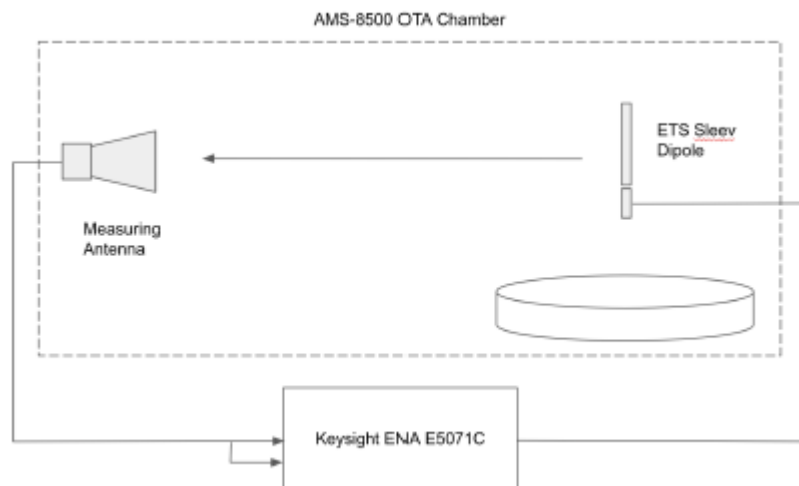


Figure: Block Diagram of Path Loss

| Frequency (MHz) | H-Pol Path Loss | V-Pol Path Loss |
|-----------------|-----------------|-----------------|
| 2402            | -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.

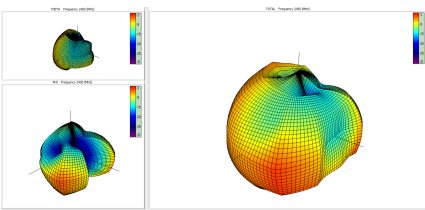
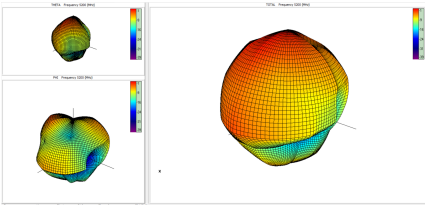
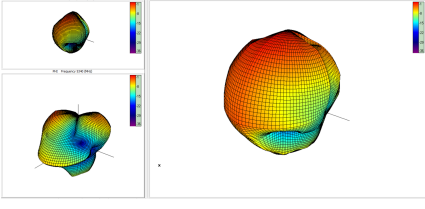
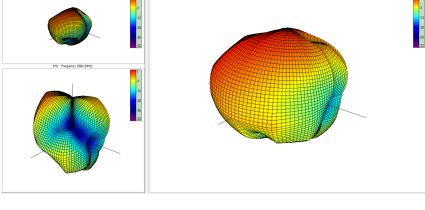
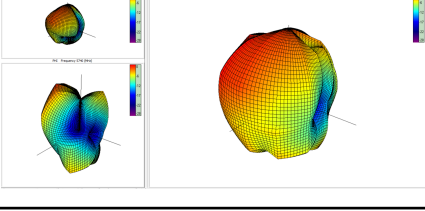
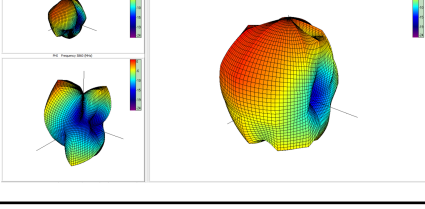
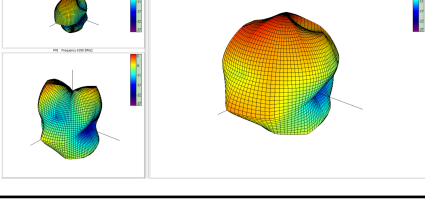
5. **Antenna Type**

| Antenna | Type |
|---------|------|
| Ant 3   | IFA  |
| Ant 4   | IFA  |

6. **WLAN/BT Antenna Test Data**

| Ant   | Band            | Frequency       | Peak Gain(dBi) |
|-------|-----------------|-----------------|----------------|
| Ant 4 | WiFi/BT 2.4 GHz | 2402 - 2480 MHz | -4.4           |
| Ant 3 | WiFi/BT 2.4 GHz | 2402 - 2480 MHz | 0.8            |
| Ant 4 | UNII-1          | 5200 MHz        | -2.9           |
|       | UNII-2A         | 5340 MHz        | -2.7           |
|       | UNII-2C         | 5580 MHz        | -1.7           |
|       | UNII-3          | 5740 MHz        | -1.8           |
|       | UNII-4          | 5860 MHz        | -2.1           |
|       | UNII-5          | 6350 MHz        | -1.8           |
|       | UNII-6          | 6450 MHz        | -1.8           |
|       | UNII-7          | 6550 MHz        | -0.9           |
|       | UNII-8          | 6875 MHz        | -2.1           |
| Ant 3 | UNII-1          | 5230 MHz        | -3.6           |
|       | UNII-2A         | 5310 MHz        | -2.3           |
|       | UNII-2C         | 5510 MHz        | -1.1           |
|       | UNII-3          | 5795 MHz        | -3.2           |
|       | UNII-4          | 5855 MHz        | -3.2           |
|       | UNII-5          | 5925 MHz        | -4.9           |
|       | UNII-6          | 6425 MHz        | -5.7           |
|       | UNII-7          | 6550 MHz        | -2.6           |
|       | UNII-8          | 6920 MHz        | -3.3           |

## 7. Radiation Plots for Max Gain Plane

| ANT   | Frequency       | Pattern                                                                              |
|-------|-----------------|--------------------------------------------------------------------------------------|
| ANT 4 | 2402 - 2480 MHz |    |
| ANT 4 | 5200 MHz        |    |
| ANT 4 | 5340 MHz        |   |
| ANT 4 | 5580 MHz        |  |
| ANT 4 | 5740 MHz        |  |
| ANT 4 | 5860 MHz        |  |
| ANT 4 | 6350 MHz        |  |