

Antenna Report

FCC ID: A4RG9S9B

December 12, 2022

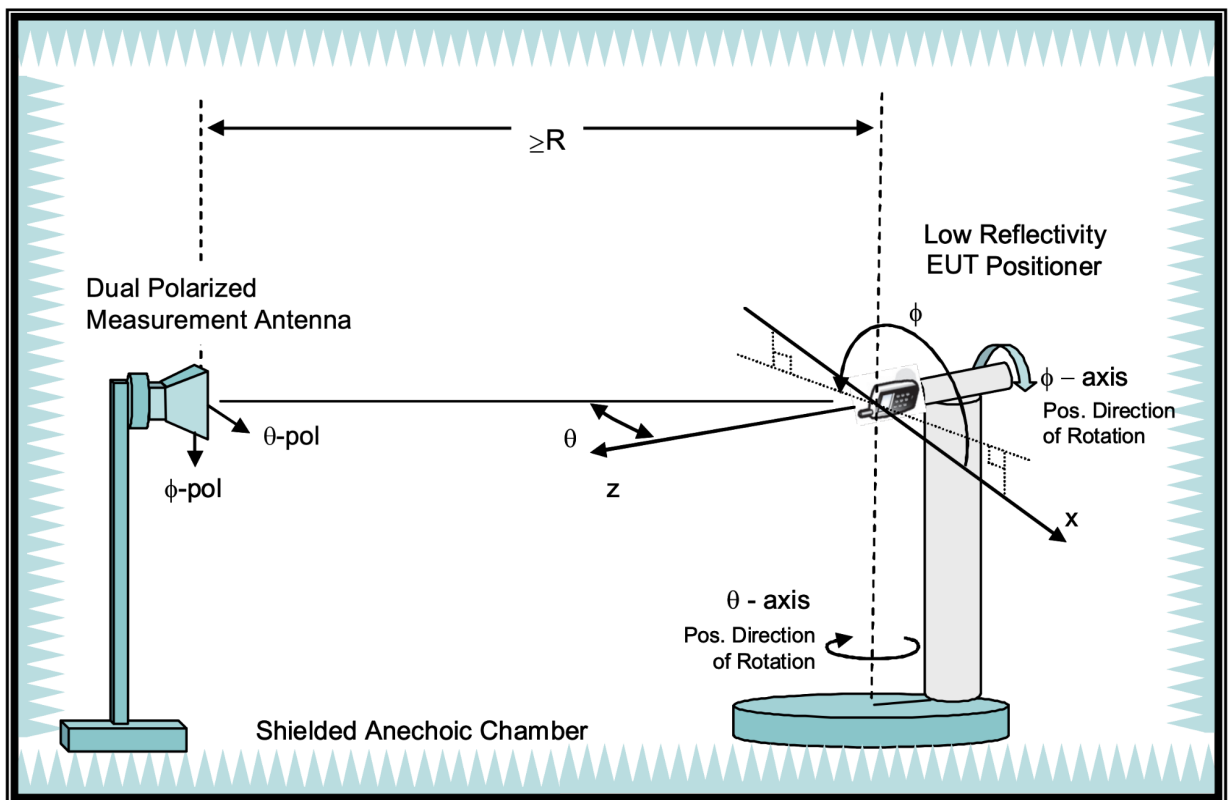
Google LLC

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 the spectrum analyzer (active) or 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 either derived directly through spatial averaging of VNA S21 measurements (passive measurement) or by the ratio of spatial averaging of 3D EIRP/TRP measurements vs the conducted power (active measurement).



Measurements were obtained through an active non-signalling measurement (test mode) plus measured conductive RF power.

2. Test Equipment

| | | |
|---------------------------------------|--|----------------------|
| Site Description | Chamber Manufacturer | Type |
| AMS-8500 Multi Probe Anechoic Chamber | ETS-Lindgren | Fully Anechoic |
| Software Version | ETS-Lindgren | EMQuest 1.210315.021 |
| Site location: | No.4, Mingsheng st., Tucheng City, New Taipei City 23678, Taiwan (R.O.C) | |
| Test Engineer | Scott Sung | |
| Date | April 28, 2021 | |

| Description | Manufacturer | Model | Calibration Date | Due Date |
|---------------------|-----------------|-------|------------------|---------------|
| Network Analyzer | - | - | - | - |
| Spectrum Analyzer | Rohde & Schwarz | FSV7 | Mar. 15, 2021 | Mar. 15, 2023 |
| Signaling Equipment | - | - | - | - |

3. Test Setup

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

4. Antenna Type

| Antenna Name | Antenna Type |
|--------------|--------------|
| Ant3 | IFA |
| Ant4 | ILA |

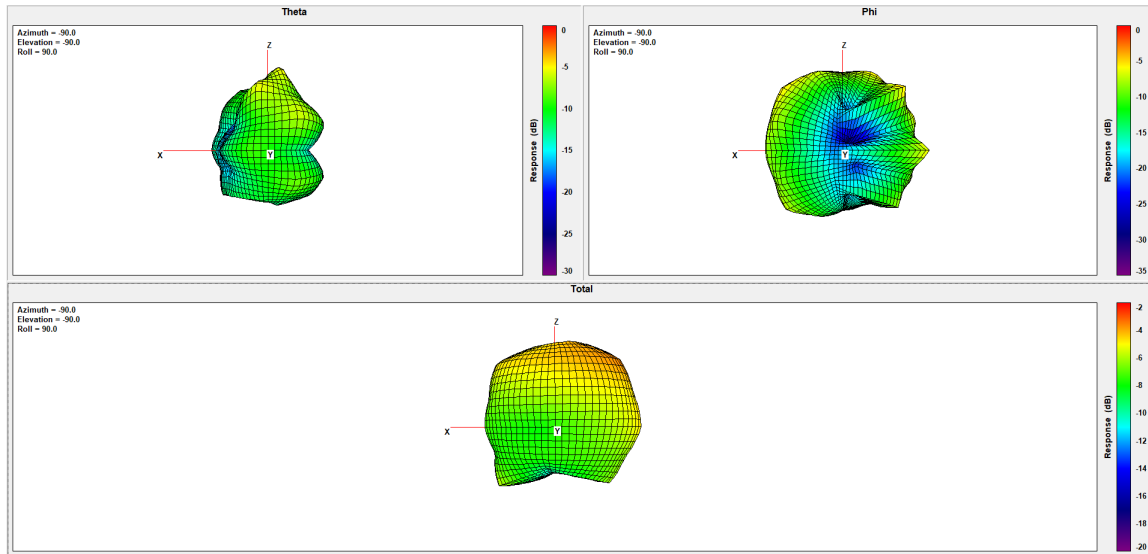
5. WLAN/BT Antennas

| Ant | Band | Frequency Band | Peak Gain(dBi) |
|-------------|-----------------|----------------|----------------|
| Ant4 | WiFi/BT 2.4 GHz | 2402 MHz | -3.2 |
| | | 2412 MHz | -3.5 |
| | | 2437 MHz | -2.6 |
| | | 2462 MHz | -2.3 |
| | | 2480 MHz | -1.2 |
| Ant3 | WiFi/BT 2.4 GHz | 2402 MHz | -1.3 |
| | | 2412 MHz | -1.7 |
| | | 2437 MHz | -1.7 |
| | | 2462 MHz | -1.3 |
| | | 2480 MHz | -1.1 |
| Ant4 | UNII-1 | 5180 MHz | -0.4 |
| | UNII-2A | 5280 MHz | -1.1 |
| | UNII-2C | 5500 MHz | -0.8 |
| | UNII-3 | 5820 MHz | 0.7 |
| | UNII-4 | 5887 MHz | 1.1 |
| | UNII-5 | 6175 MHz | -0.3 |
| | UNII-6 | 6475 MHz | 0.4 |
| | UNII-7 | 6700 MHz | 0.0 |
| | UNII-8 | 7000 MHz | 0.5 |
| Ant3 | UNII-1 | 5180 MHz | -3.6 |
| | UNII-2A | 5280 MHz | -4.1 |
| | UNII-2C | 5500 MHz | -1.9 |
| | UNII-3 | 5820 MHz | -1.8 |
| | UNII-4 | 5887 MHz | 0.1 |
| | UNII-5 | 6175 MHz | -1.4 |
| | UNII-6 | 6475 MHz | 0.4 |
| | UNII-7 | 6700 MHz | 0.9 |
| | UNII-8 | 7000 MHz | -1.3 |

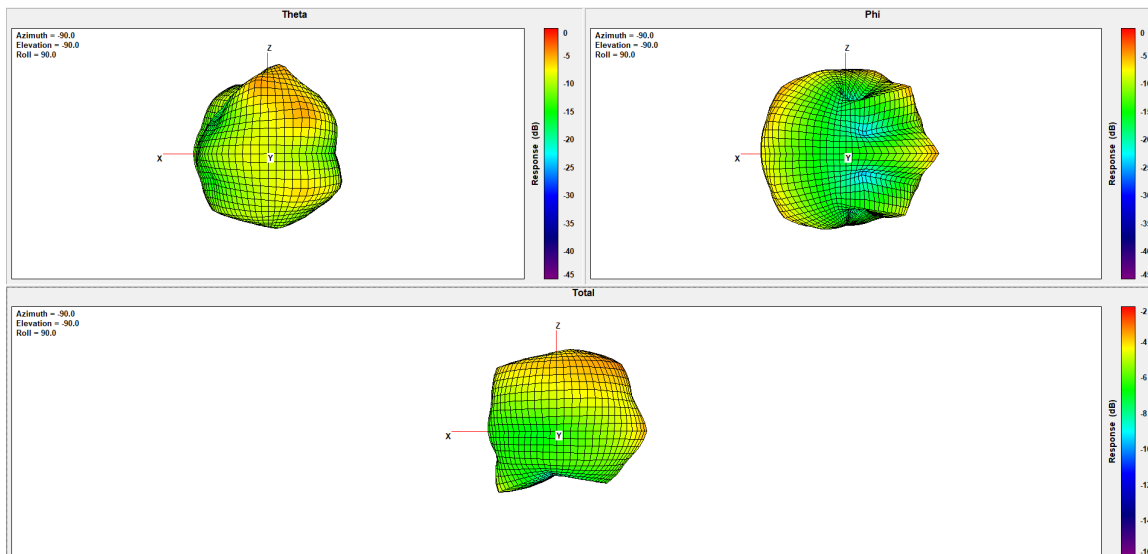
Appendix: Radiation Plots

Ant4:

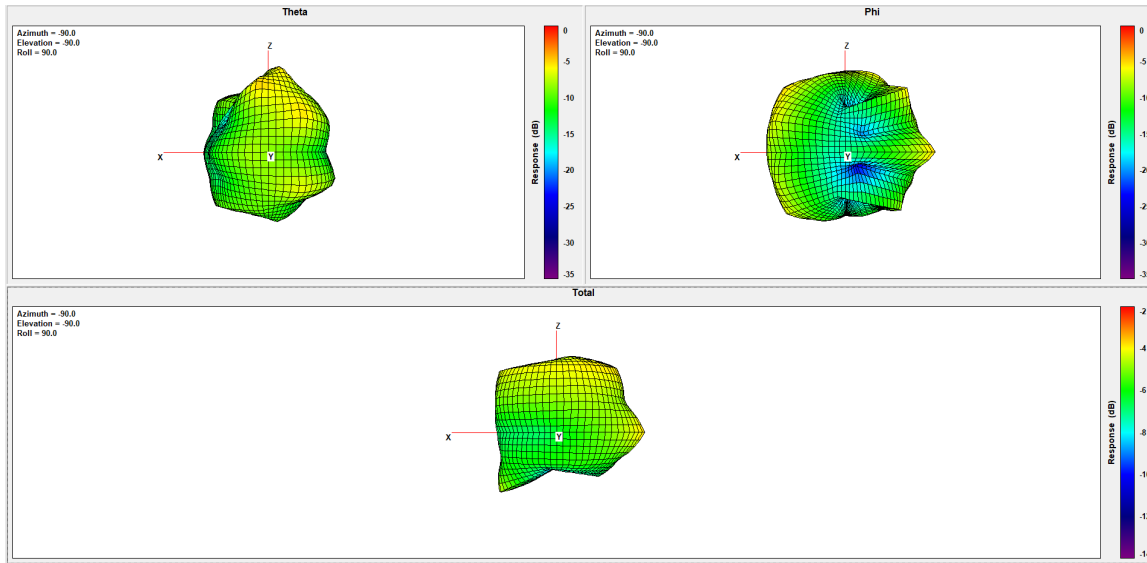
Ant4 Freq. 2412 MHz:



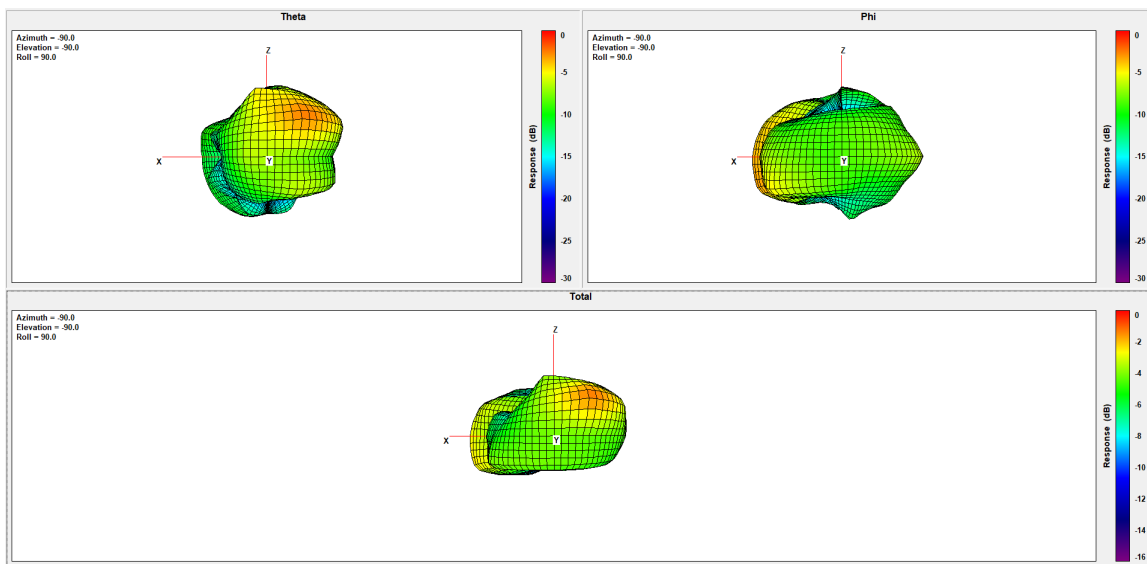
Ant4 Freq. 2437 MHz:



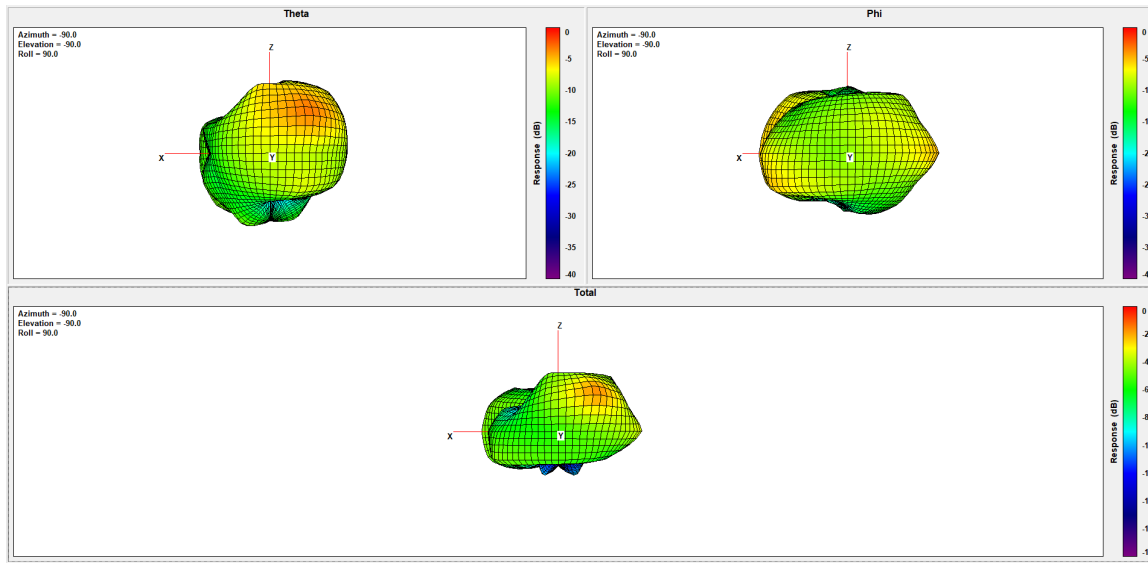
Ant4 Freq. 2462 MHz:



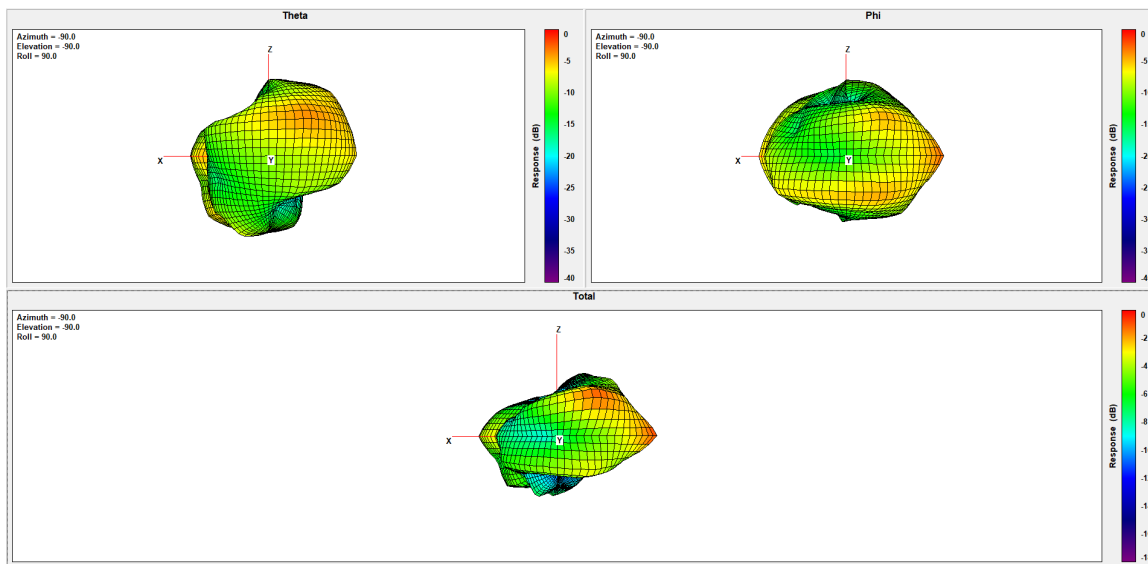
Ant4 Freq. 5180 MHz:



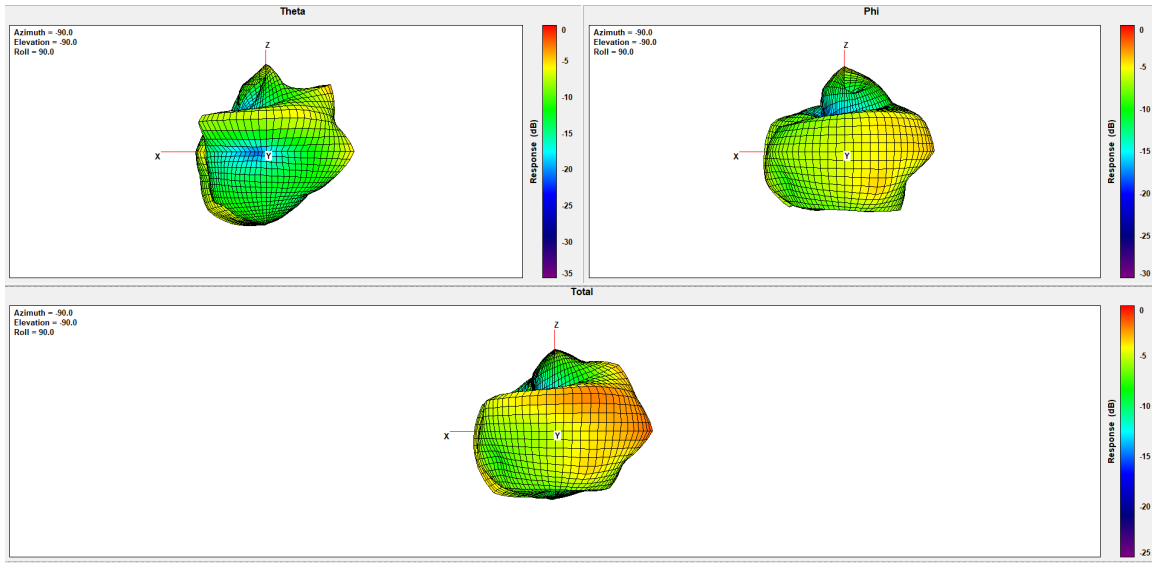
Ant4 Freq. 5280 MHz:



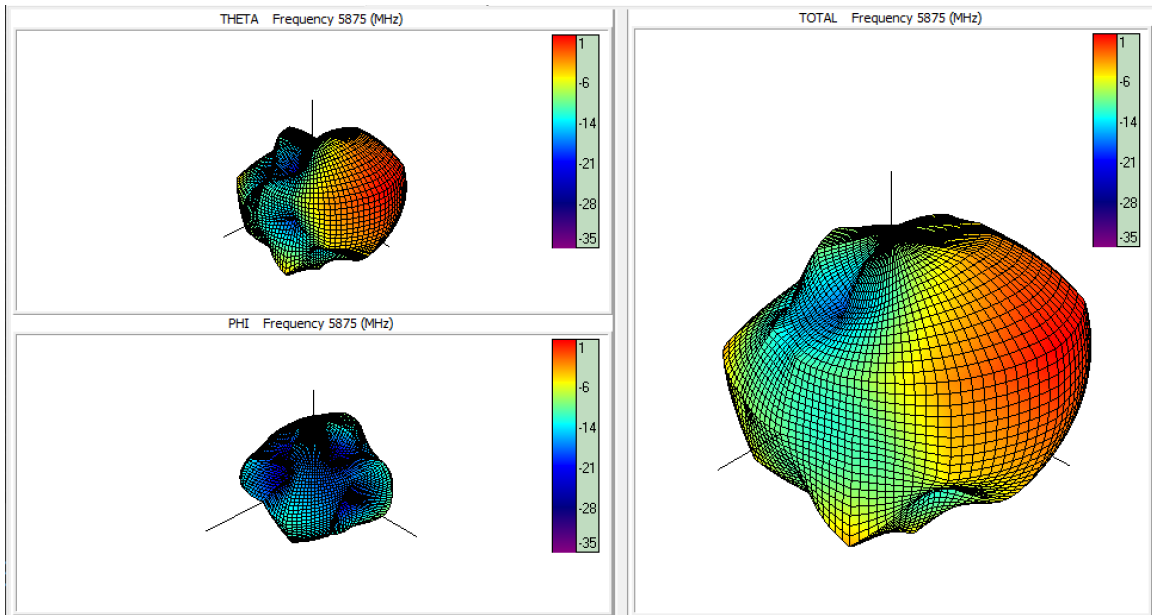
Ant4 Freq. 5500 MHz:



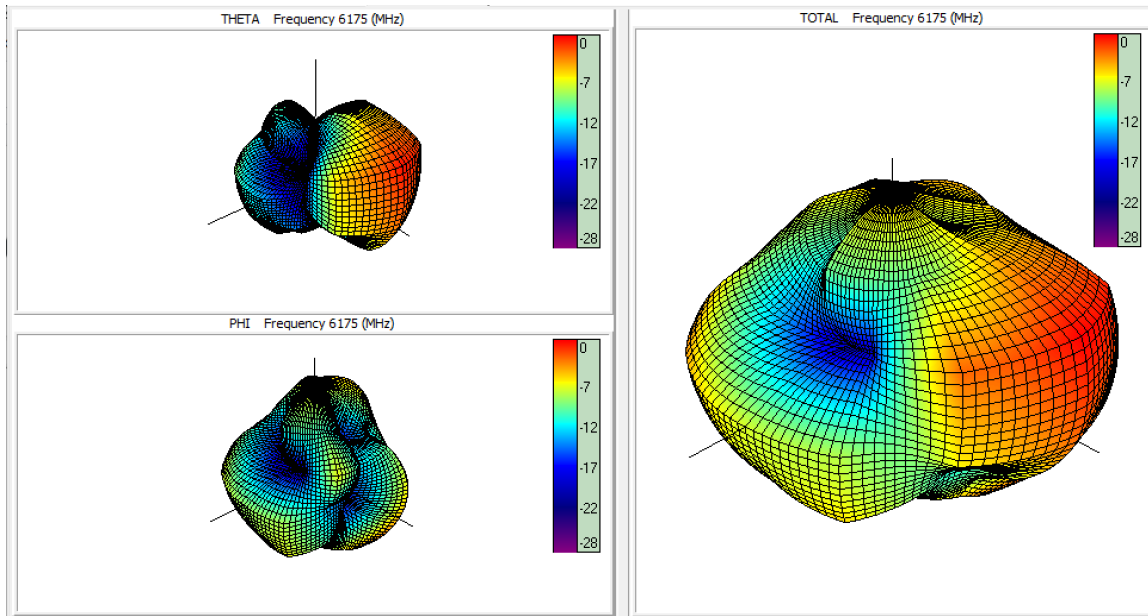
Ant4 Freq. 5825 MHz:



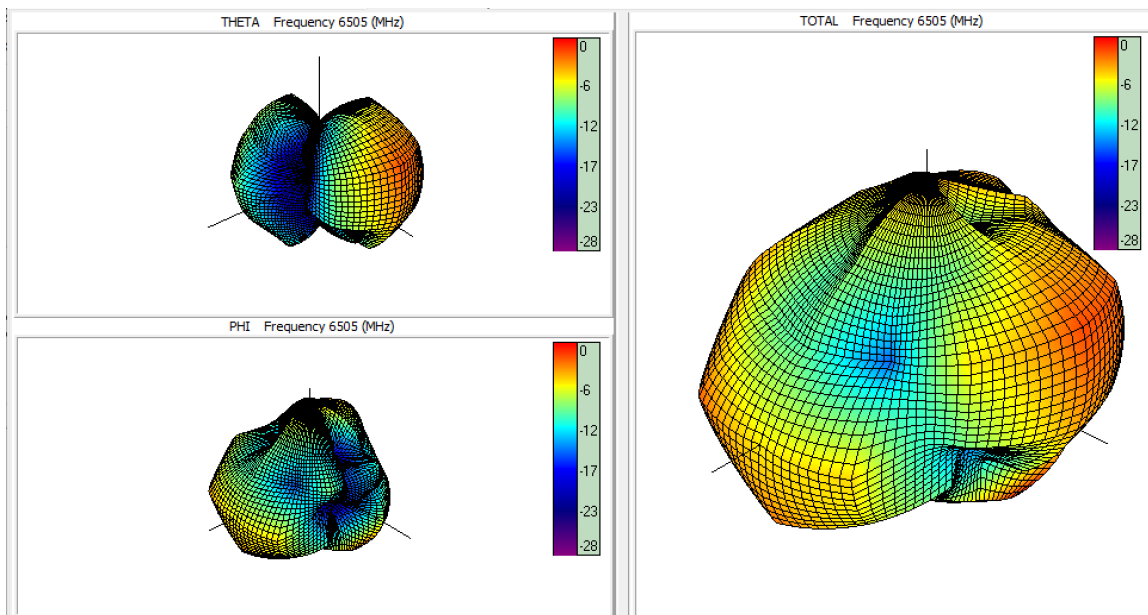
Ant4 Freq. 5887 MHz:



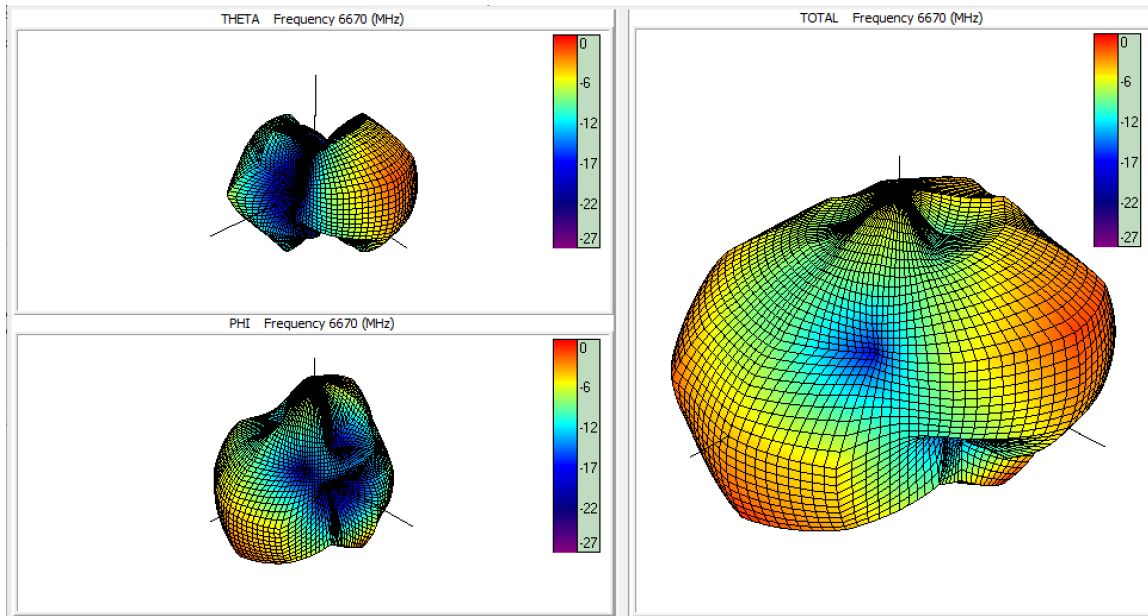
Ant4 Freq. 6175 MHz:



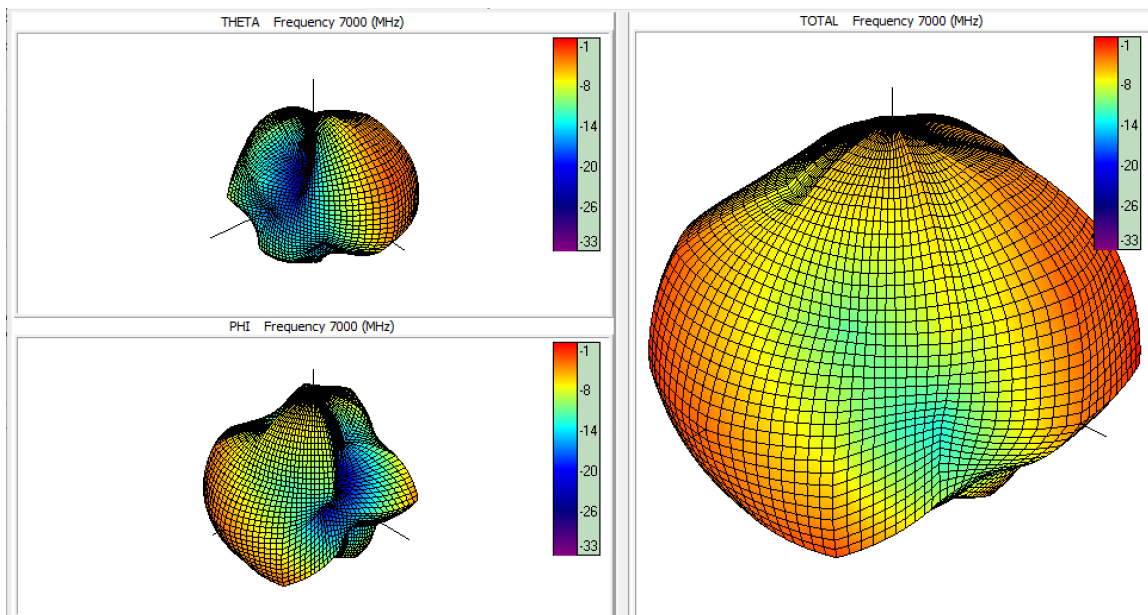
Ant4 Freq. 6475 MHz:



Ant4 Freq. 6700 MHz:

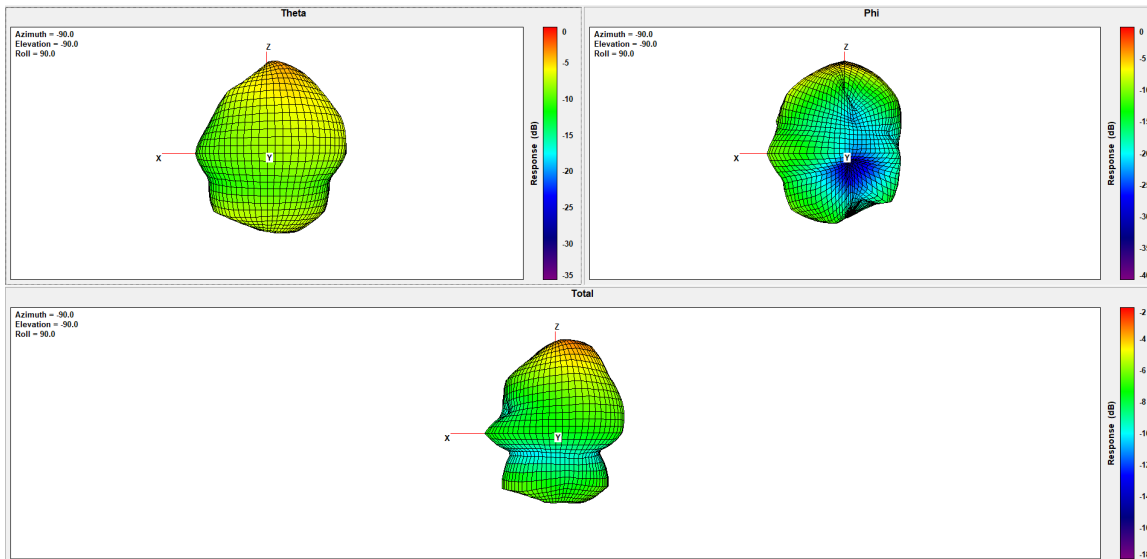


Ant4 Freq. 7000 MHz:

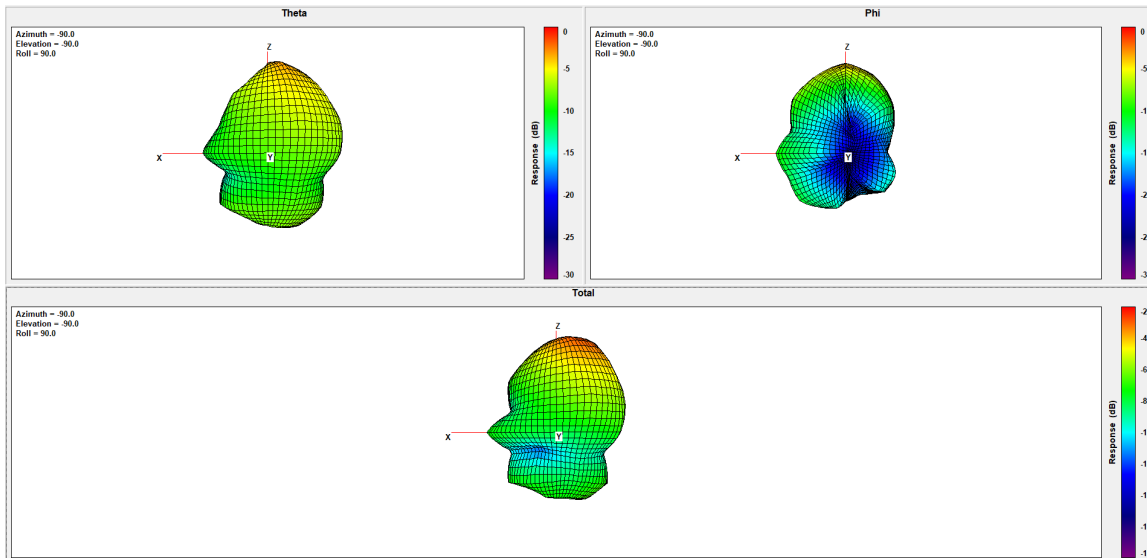


Ant3:

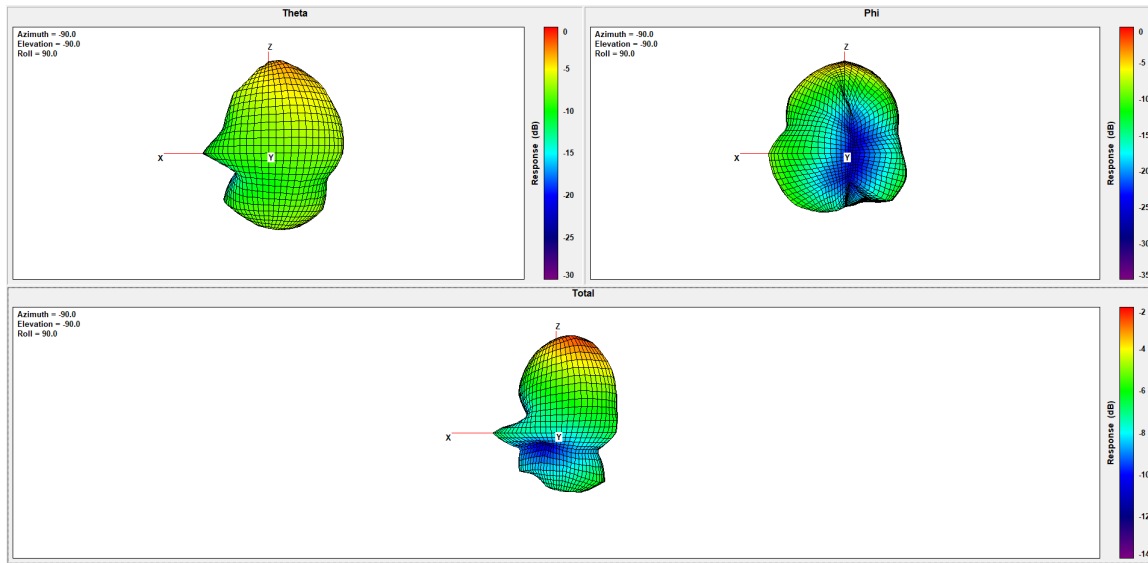
Ant3 Freq. 2412 MHz:



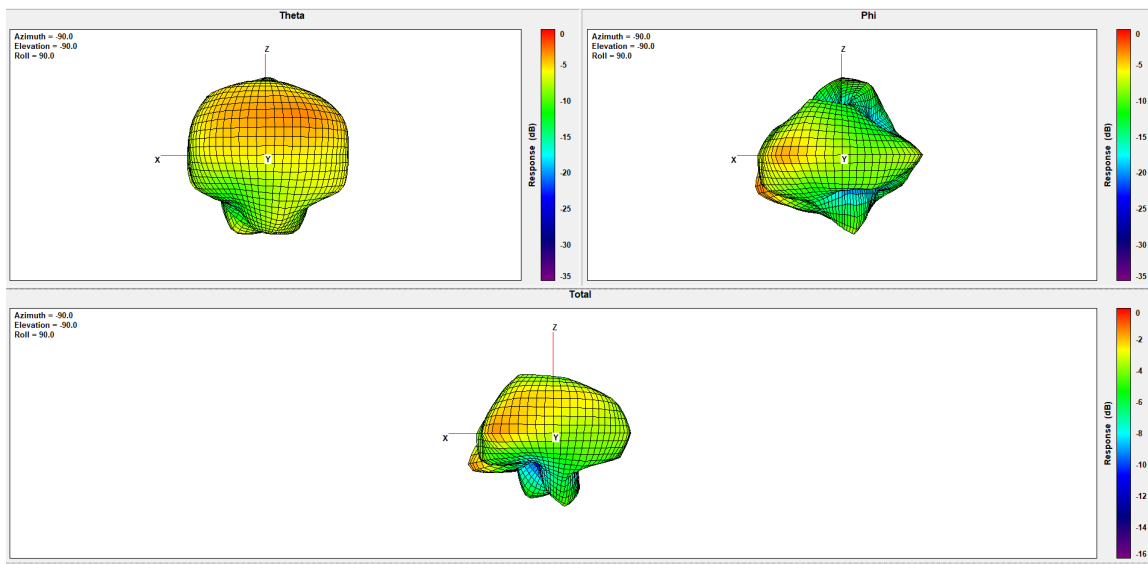
Ant3 Freq. 2437 MHz:



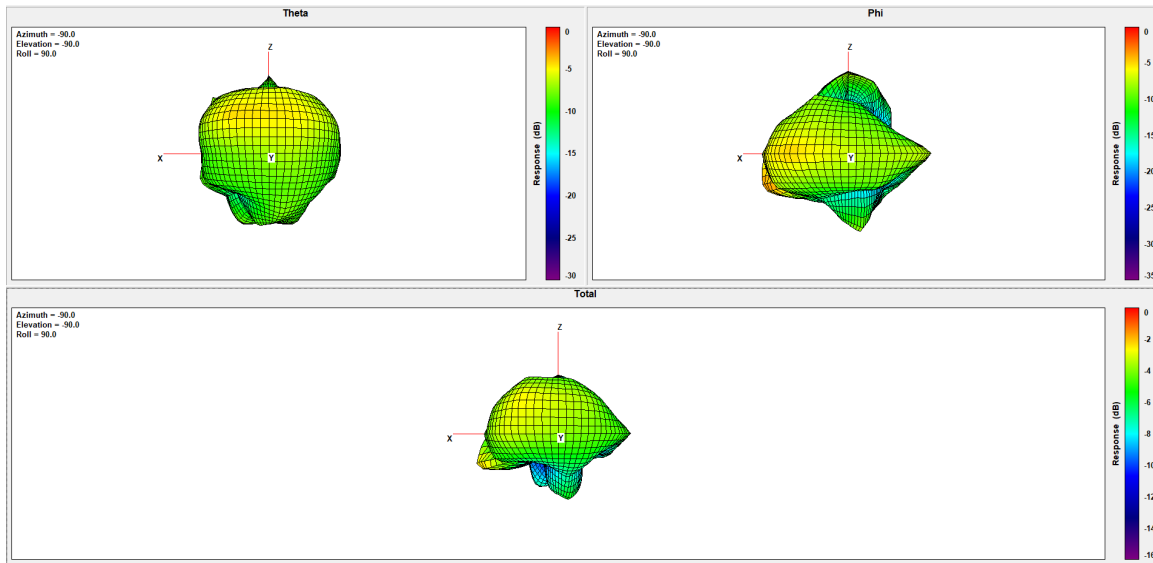
Ant3 Freq. 2462 MHz:



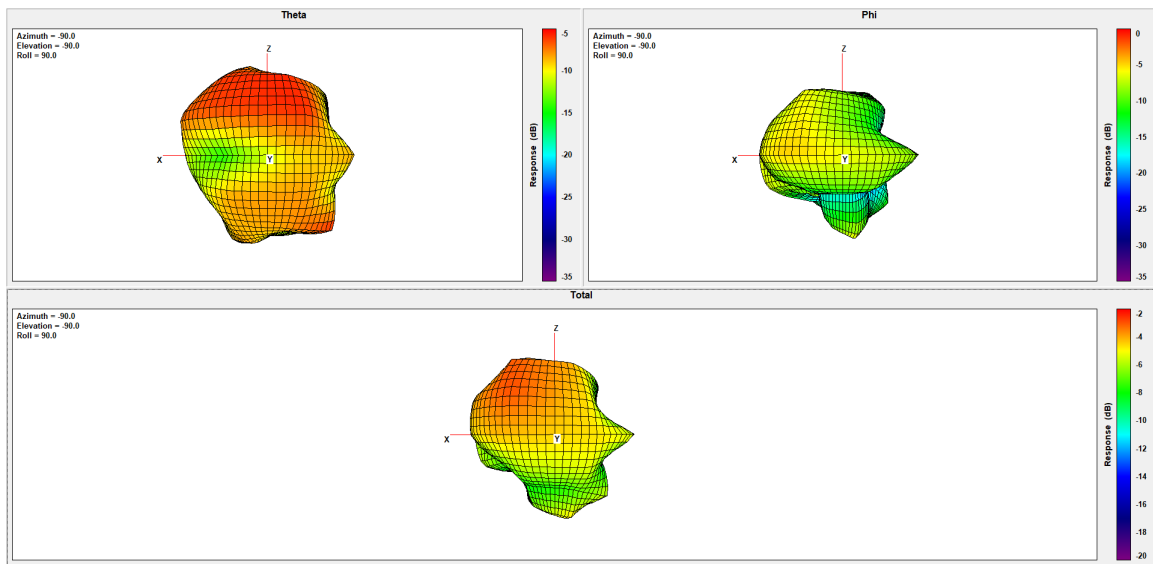
Ant3 Freq. 5180 MHz:



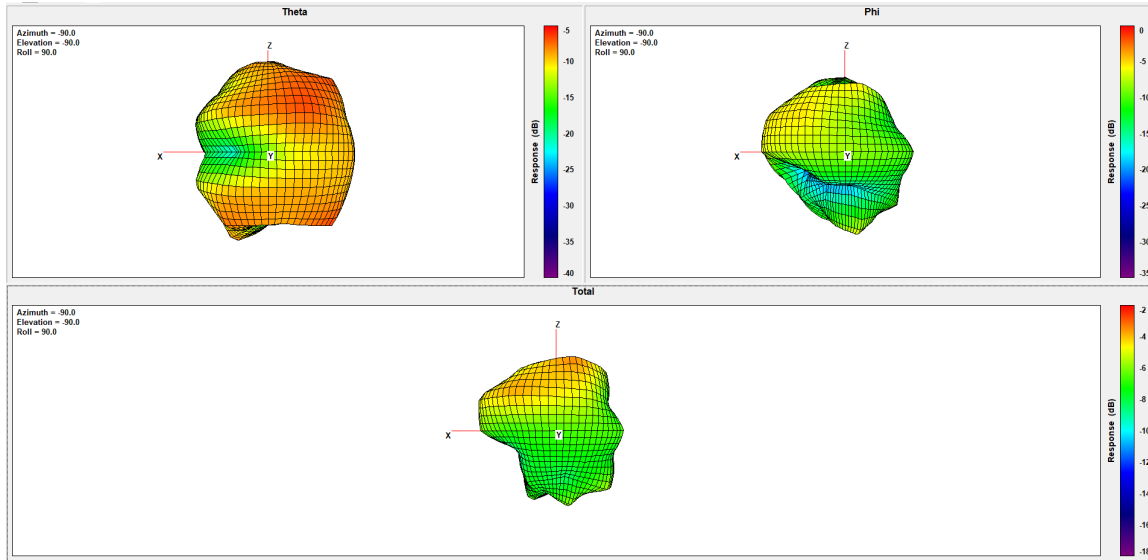
Ant3 Freq. 5280 MHz:



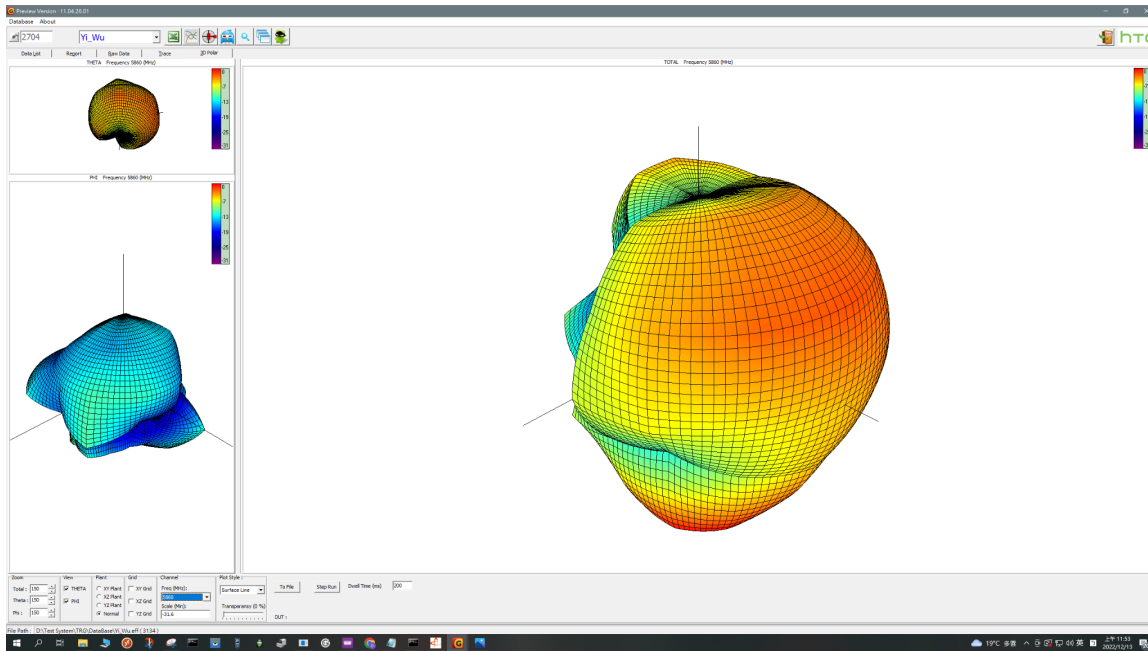
Ant3 Freq. 5500 MHz:



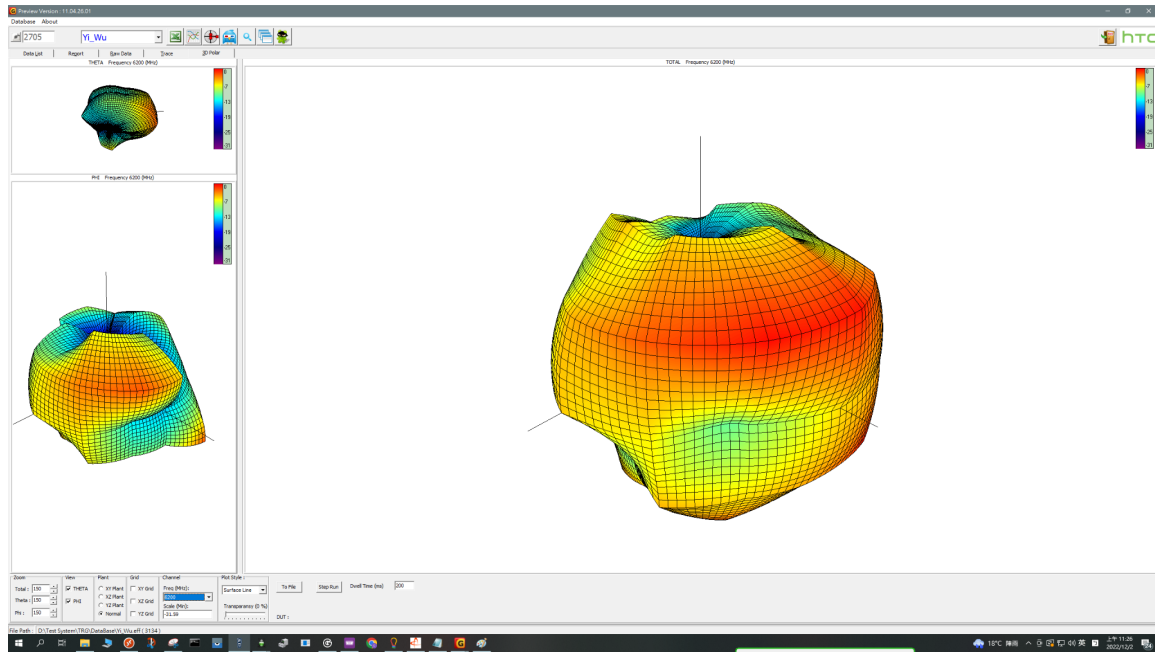
Ant3 Freq. 5825 MHz:



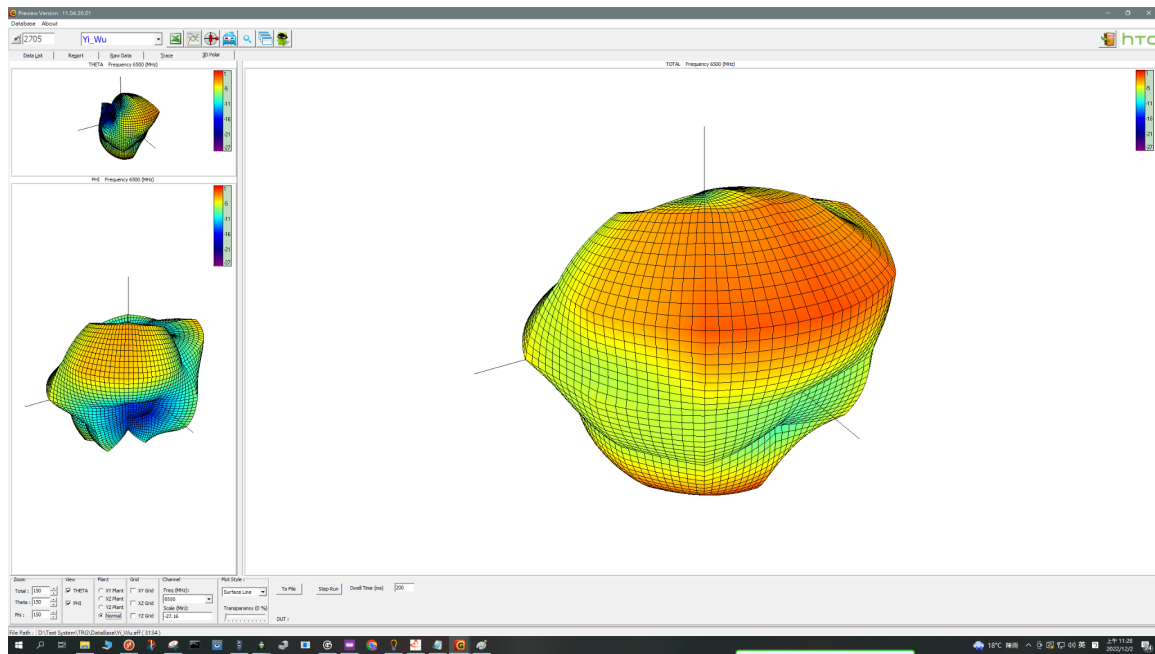
Ant3 Freq. 5887 MHz:



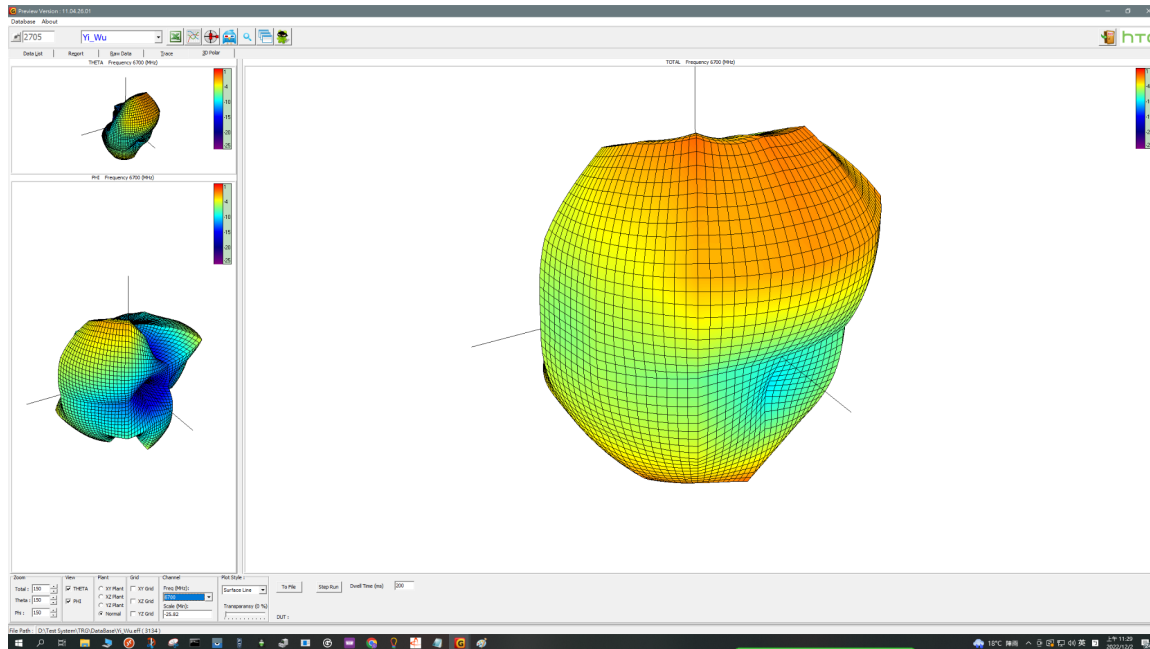
Ant3 Freq. 6175 MHz:



Ant3 Freq. 6475 MHz:



Ant3 Freq. 6700 MHz:



Ant3 Freq. 7000 MHz:

