

FCC Part 15 Antenna Gain

Test Report

Test Dates: 5/17/26 – 6/7/26

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	Rev	SHEET	Abhishek Rala
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1. Scope

This test report demonstrates compliance with the antenna gain reporting requirements of FCC 2.1033(b)(7), 15.203, 15.212.

2. Reference Documents

FCC 2.1033(b)(7), 15.203, 15.212

3. Test Personnel

Test personnel are valued team members. Their expertise insures accurate test results. Their identities are considered confidential by Apple.

4. Test Equipment

Test Equipment	Critical Specifications	Cal due date
Antenna Measurement System	Fully anechoic OTA chamber with dual-polarized measurement antenna, mechanical positioners of Theta and Phi axes, and RF path switching. Frequency Range.	8/8/25
Power Meter - R&S NRP	Frequency Range, Power Input Range	8/8/25

5. Commercial Test Software

The test equipment operates under the control of commercial test software. For OTA chambers sold by ETS Lindgren, EMQuest v1.14 is used.

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6. Test Method

EIRP measurement is based on industry-standard method described in CTIA OTA Test Plan (current version 3.9.4). Peak gain (Horizontal and Vertical Polarization) is calculated by subtracting Conducted Power from the measured maximum EIRP. Testing is performed with Antenna integrated in the product Below is the measurement summary from the specification:

Figure 4-2 shows a typical real world configuration for measuring the path loss. In this case, a reference antenna with known gain is used in place of the theoretical isotropic source. The path loss may then be determined from the power into the reference antenna by adding the gain of the reference antenna. That is:

EQUATION 4.2

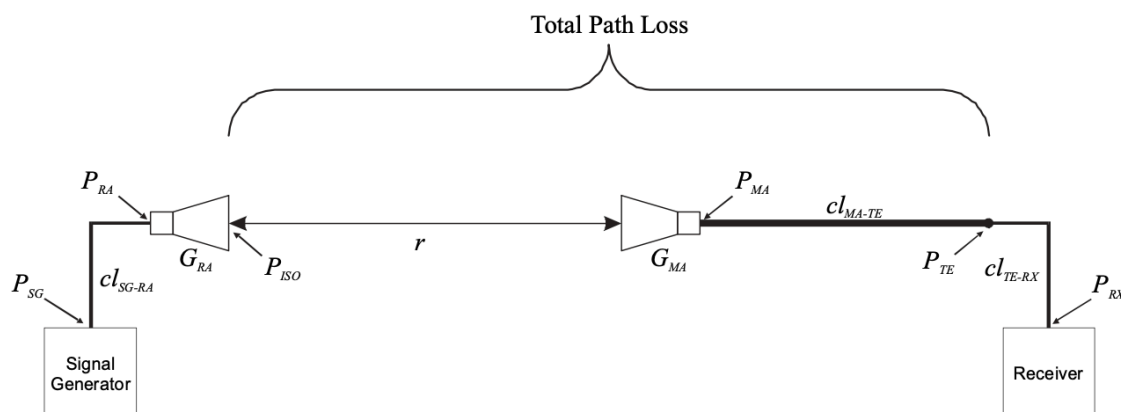
$$P_{ISO} = P_{RA} + G_{RA}$$

where P_{RA} is the power radiated by reference antenna, and G_{RA} is the gain of the reference antenna, so that:

EQUATION 4.3

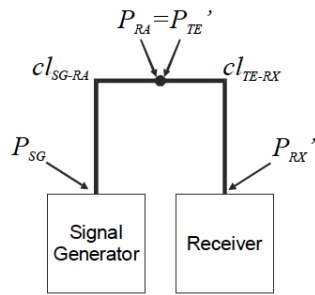
$$PL = P_{RA} + G_{RA} - P_{TE}$$

FIGURE 4-2 TYPICAL CONFIGURATION FOR MEASURING PATH LOSS



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FIGURE 4-3 CABLE REFERENCE CALIBRATION CONFIGURATION



where P_{RX}' is the power measured at the receiver during the cable reference test, and P_{RX} is the power measured at the receiver during the range path loss measurement in Figure 4-2. Note that this formulation assumes that the effects of the reference antenna VSWR are accounted for in the gain of the reference antenna. For more information on this subject, refer to [1]. Thus, the path loss is then just given by:

EQUATION 4.5

$$PL = G_{RA} + P_{RX}' - P_{RX}$$

7. MIMO Peak Gain Calculation

For MIMO $G(\theta, \phi)$ calculations, correlated and uncorrelated gains are calculated at each (θ, ϕ) using the following process.

For each (band, channel) pair:

- The 3D EIRP pattern measured per antenna and per polarization, sampled on a 12×24 (θ, ϕ) grid at 15° steps (elevation $\theta \in \{0^\circ, 15^\circ, \dots, 165^\circ\}$; azimuth $\phi \in \{0^\circ, 15^\circ, \dots, 345^\circ\}$).
- The conducted power (dBm) at each antenna port for that channel, measured separately from the OTA pattern.

For each antenna $A \in \{\text{LAT}, \text{UAT}\}$, polarization $p \in \{\text{H}, \text{V}\}$, and grid point (θ, ϕ) , the single-Tx antenna gain is obtained by subtracting the conducted power from the measured EIRP:

$$G_A[p, \theta, \phi] = \text{EIRP}_A[p, \theta, \phi] - P_{A, \text{conducted}}$$

All terms are in dB (EIRP and conducted power in dBm; gain in dBi).

At every grid point, with the same polarization on both antennas, the two-antenna MIMO gains are computed as:

$$\text{Correlated}(p, \theta, \phi) = 10 \cdot \log_{10} [(10^{(G_{\text{UAT}}/20)} + 10^{(G_{\text{LAT}}/20)})^2 / N]$$

$$\text{Uncorrelated}(p, \theta, \phi) = 10 \cdot \log_{10} [(10^{(G_{\text{UAT}}/10)} + 10^{(G_{\text{LAT}}/10)}) / N]$$

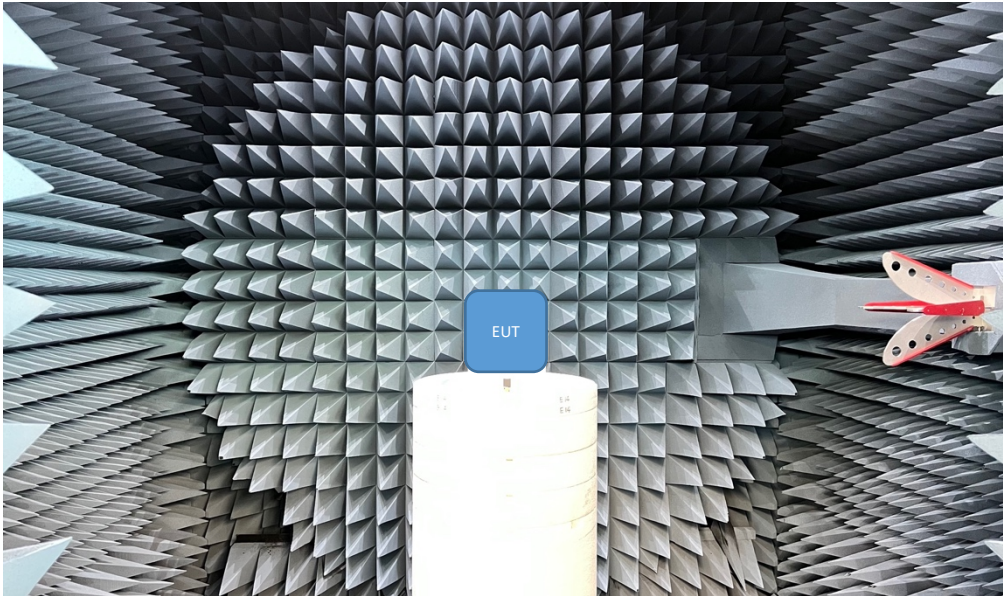
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where $N = 2$ is the number of transmit antennas.

Independently for the Correlated and Uncorrelated grids, the reported peak is the max taken over the full (polarization, θ , ϕ) search space ($2 \times 12 \times 24 = 576$ points).

8. Typical Test Setup

The device containing the integral antenna is placed on the styrofoam pylon (inside the OTA chamber) as pictured below.



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9. Test results

See antenna gain exhibit

10. Antenna Photos or Drawings

See internal photos exhibit

11. Antenna Description

See technical description exhibit and antenna gain exhibit

12. Revision History

Revision #	Date	Description of Change
1.0	March 10th, 2026	Original

END OF DOCUMENT

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