Antenna Test Report

The gain of each antenna is measured in a fully anechoic chamber certified by CTIA OTA. The individual gains of all antennas are then mathematically summed at the same spatial position (azimuth and elevation) across all points in a spherical antenna pattern, following the FCC KDB 662911 D01 guidelines to compute the directional antenna gain.

1. General Information of Equipment Under Test

Equipment	Wireless Router
Brand Name	eero
Model Name	PA10001
Applicant	eero LLC
Manufacturer	eero LLC

2. Test Location

Test Site	Sporton International Inc. (Kunshan)
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL: +86-0512-5790-0158
Test Site No.	**Sporton Site No.**
	OTA04-KS

Test Method	Test Engineer	Environment (℃ / %)	Test Date
Radiated	Emma Zhou	24~25 / 30~40	Nov. 22, 2024

3. Test Frequency

Band (MHz)	Test Frequency (MHz)
2400-2480	2400, 2437, 2480
5150-5250	5150, 5220, 5250
5250-5350	5250, 5300, 5350
5470-5725	5470, 5580, 5725
5725-5850	5725, 5785, 5850
5850-5895	5850, 5865, 5895

4. Antenna Information

Ant. Position	Brand Name	Model Name	Ant. Type	Connector
Antenna #0 (WLAN 2.4GHz/5GHz)	Luxshare-ICT	833-01900	DIPOLE	IPEX
Antenna #1 (WLAN 2.4GHz/5GHz)	Luxshare-ICT	833-01901	DIPOLE	IPEX
Antenna #2 (Bluetooth & ZigBee)	Luxshare-ICT	833-01902	DIPOLE	IPEX

5. Test Results:

5.1 Individual Antenna Gain

Maximum Antenna Gains of Individual Antennas				
Antenna	**Frequency (MHz)**	**Antenna gain (dBi)**	**Theta**	**Phi**
#0	2400MHz	5.41(dBi)	45	165
#0	2437MHz	3.87(dBi)	50	165
#0	2480MHz	3.31(dBi)	30	285
#0	5150MHz	3.63(dBi)	95	210
#0	5220MHz	3.85(dBi)	100	180
#0	5250MHz	4.09(dBi)	100	185
#0	5300MHz	4.16(dBi)	45	230
#0	5350MHz	4.52(dBi)	100	195
#0	5470MHz	5.5(dBi)	100	200
#0	5580MHz	5.7(dBi)	105	200
#0	5725MHz	5.01(dBi)	95	175
#0	5785MHz	5.42(dBi)	95	175
#0	5850MHz	5.29(dBi)	75	180
#0	5865MHz	5.26(dBi)	75	180
#0	5895MHz	5.39(dBi)	75	180
#1	2400MHz	4.13(dBi)	35	315
#1	2437MHz	4.14(dBi)	35	315
#1	2480MHz	4.79(dBi)	20	265
#1	5150MHz	2.76(dBi)	85	345
#1	5220MHz	3.92(dBi)	90	340
#1	5250MHz	3.91(dBi)	90	340
#1	5300MHz	4(dBi)	115	5
#1	5350MHz	4.56(dBi)	115	5
#1	5470MHz	5.34(dBi)	100	360
#1	5580MHz	4.97(dBi)	110	360
#1	5725MHz	5.09(dBi)	105	360
#1	5785MHz	5.25(dBi)	95	355
#1	5850MHz	5.33(dBi)	90	355
#1	5865MHz	5.33(dBi)	95	355
#1	5895MHz	5.2(dBi)	100	0
#2	2400MHz	2.97(dBi)	5	160
#2	2437MHz	2.51(dBi)	30	285
#2	2480MHz	3.02(dBi)	25	275

Maximum Antenna Gains of Individual Antennas for Elevation Angle above 30 Degrees				
Antenna	**Frequency (MHz)**	**Antenna gain (dBi)**	**Theta**	**Phi**
#0	5150MHz	3.63(dBi)	95	210
#0	5220MHz	3.85(dBi)	100	180
#0	5250MHz	4.09(dBi)	100	185
#1	5150MHz	2.76(dBi)	85	345
#1	5220MHz	3.92(dBi)	90	340
#1	5250MHz	3.91(dBi)	90	340

5.2 Directional Antenna Gain

Directional gains						
Frequency (MHz)	2400	2437	2480			
Ant. #0 Gain (dBi)	5.41	2.07	2.99			
Ant. #1 Gain (dBi)	-0.01	3.36	4.3			
(Theta, Phi)	45,165	20,270	25,280			
Directional Gain - Correlated (dBi)	6.12	5.75	6.68			
Ant. #0 Gain (dBi)	5.41	2.07	2.63			
Ant. #1 Gain (dBi)	-0.01	3.36	4.57			
(Theta, Phi)	45,165	20,270	25,275			
Directional Gain - Uncorrelated (dBi)	3.49	2.76	3.71			
Frequency (MHz)	5150	5220	5250	5300	5350	5470
Ant. #0 Gain (dBi)	-3.15	-1.82	-1.32	-0.88	-0.29	-1.43
Ant. #1 Gain (dBi)	2.58	3.61	3.71	3.53	3.67	4.25
(Theta, Phi)	95,345	95,345	95,345	95,345	95,345	100,345
Directional Gain - Correlated (dBi)	3.19	4.32	4.57	4.61	4.92	4.88
Ant. #0 Gain (dBi)	3.63	-2.49	-1.85	-1.36	-0.29	5.5
Ant. #1 Gain (dBi)	-12.32	3.92	3.91	3.74	3.67	-15.81
(Theta, Phi)	95,210	90,340	90,340	90,340	95,345	100,200
Directional Gain - Uncorrelated (dBi)	0.73	1.8	1.92	1.9	2.12	2.52
Frequency (MHz)	5580	5725	5785	5850	5865	5895
Ant. #0 Gain (dBi)	-1.25	-2.77	-3.67	-3.39	-3.37	-3.13
Ant. #1 Gain (dBi)	3.87	4.7	4.96	4.87	4.84	4.61
(Theta, Phi)	100,350	100,355	100,355	100,355	100,355	100,350
Directional Gain - Correlated (dBi)	4.69	4.75	4.68	4.69	4.68	4.58
Ant. #0 Gain (dBi)	5.7	-2.77	5.42	-5.87	-5.55	5.39
Ant. #1 Gain (dBi)	-18.73	4.7	-6.29	5.3	5.33	-8.56
(Theta, Phi)	105,200	100,355	95,175	95,355	95,355	75,180
Directional Gain - Uncorrelated (dBi)	2.7	2.4	2.7	2.61	2.66	2.55

Directional gains for Elevation Angle above 30 Degrees						
Frequency (MHz)	5150	5220	5250			
Ant. #0 Gain (dBi)	-3.15	-1.82	-1.32			
Ant. #1 Gain (dBi)	2.58	3.61	3.71			
(Theta, Phi)	95,345	95,345	95,345			
Directional Gain - Correlated (dBi)	3.19	4.32	4.56			
Ant. #0 Gain (dBi)	3.63	-2.49	-1.85			
Ant. #1 Gain (dBi)	-12.32	3.92	3.91			
(Theta, Phi)	95,210	90,340	90,340			
Directional Gain - Uncorrelated (dBi)	0.73	1.8	1.92			

The composite gain of the antenna is calculated using the formula in clause F)2)d)i) of KDB 662911 D01 v02r01, which determines the measured directional gain at the same spatial position (Theta, Phi) after measuring each individual antenna.

The F)2)d)i)and F)2)d)ii) of KDB 662911 D01 v02r01:

d) *Unequal antenna gains, with equal transmit powers.* For antenna gains given by G_1, G_2, …, G_N dBi

(i) If transmit signals are *correlated*, then

Directional gain = $10 \log[(10^{G_1/20} + 10^{G_2/20} + \ldots + 10^{G_N/20})^2 / N_{ANT}]$ dBi [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

(ii) If all transmit signals are *completely uncorrelated*, then

Directional gain = $10 \log[(10^{G_1/10} + 10^{G_2/10} + \ldots + 10^{G_N/10})/N_{ANT}]$ dBi

6. Radiated Measurement Method and Environment:

The directional gain is measured using a gain-comparison method, with the antenna under test positioned inside an anechoic chamber that meets the following specifications:

- Overall dimensions (L x W x H) : 7.5m x 3.9m x 3.9m (rectangular chamber)
- Antenna measured frequency range: 700MHz to 10GHz
- Quiet zone (cylindrical volume): diameter: 50cm, height: 36cm

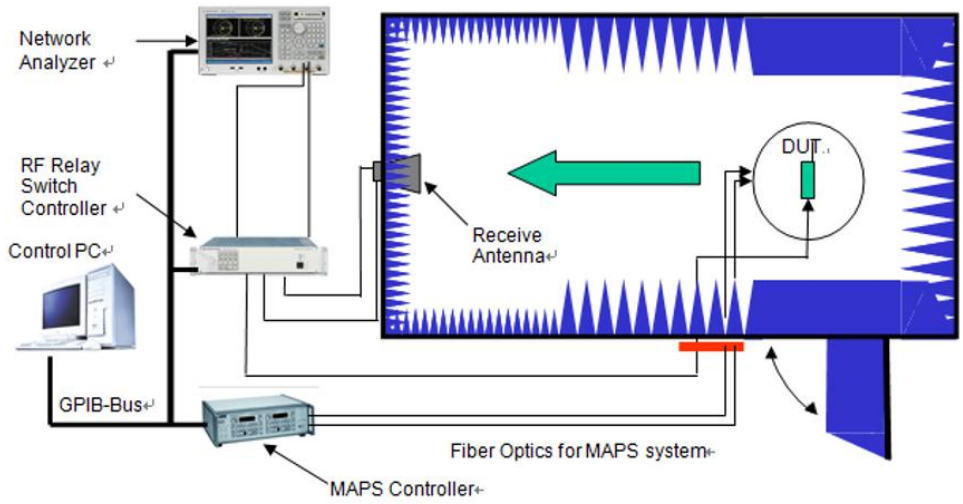


Fig.1 Anechoic Chamber: ETS-Lindgren AMS-8500 (Qualified for CTIA OTA measurement)

6.1 Radiated Test Procedure:

i. This test procedure primarily adheres to Section 3 of the CTIA Test Plan [1], which outlines the scope of measurement. The total range loss—comprising air loss, receiving antenna loss, and cable loss—has been pre-calibrated by comparing it with a calibrated antenna (ETS-Lindgren Sleeve dipole and horn antenna 3117). While conducting the radiated test on the Device Under Test (DUT), the total range loss has been taken into account for final results.

ii. The Device Under Test (DUT) is positioned on a three-dimensional (3D) fixture constructed from low-dielectric material. One of the DUT's antennas is connected to the network analyzer, while the input port of the other antenna is properly terminated.

iii. A three-dimensional characterization of the antenna performance of the DUT is pieced together by analyzing the data from the spatially distributed measurements. Data points taken every 5 degrees in the theta and in the phi axes are deemed sufficient to fully characterize the DUT's Far-Field radiation pattern and total radiated power.

iv. The antenna gain is reported in Section 5.1 of this document and antenna patterns in Appendix A, respectively.

v. Repeatedly test the other antenna by following the step iii to step v.

vi. Once the individual antenna gains have been measured, the directional antenna gain is calculated using clauses F)2)d)i) and F)2)d)ii) of FCC KDB 662911 D01. In this process, the gains of all antennas are mathematically summed at the same azimuth and elevation position. The resulting superposition of the measured directional gains is reported in Section 5.2 of this document, while the antenna patterns can be found in Appendix A.

Fig.2 Test Chamber – Network Analyzer

6.2 Test Equipment:

OTA04-KS					
Instrument	**Brand Name**	**Type/Model**	**Serial Number**	**Last Cal.**	**Due Date**
Network Analyzer	Agilent	E5071C	MY46317418	2024/01/04	2025/01/03
Switch Control	ETS-Lindgren	EMCenter	00160100	NCR	NCR
Diagonal Dual Polarized Horn	ETS-Lindgren	3164-08	00099205	NCR	NCR
Multi-Devices Controller	ETS-Lindgren	2090-OPT1	00066604	NCR	NCR
Medium Duty Holder	ETS-Lindgren	2015	N/A	NCR	NCR

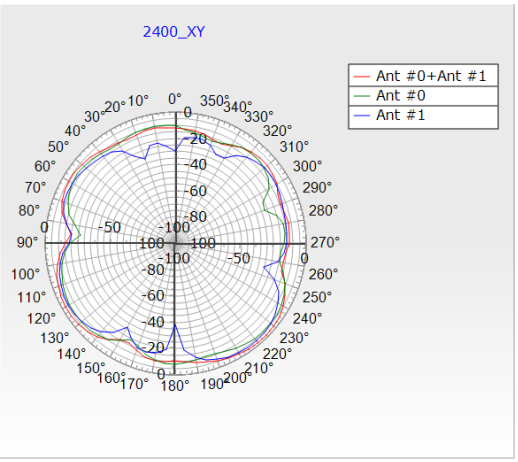
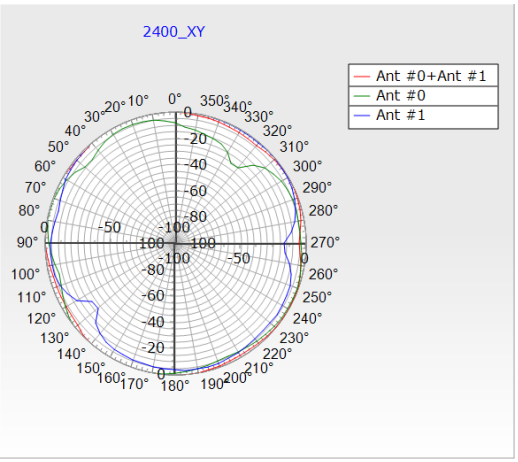
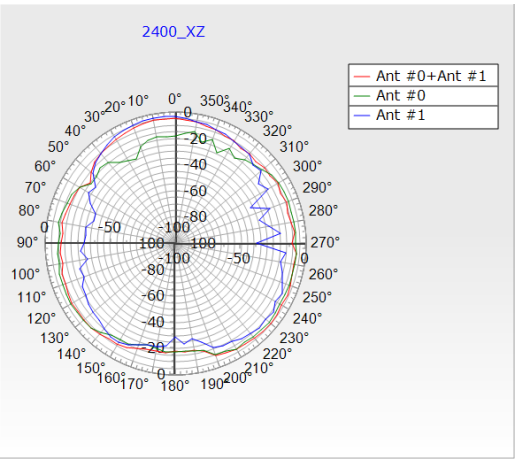
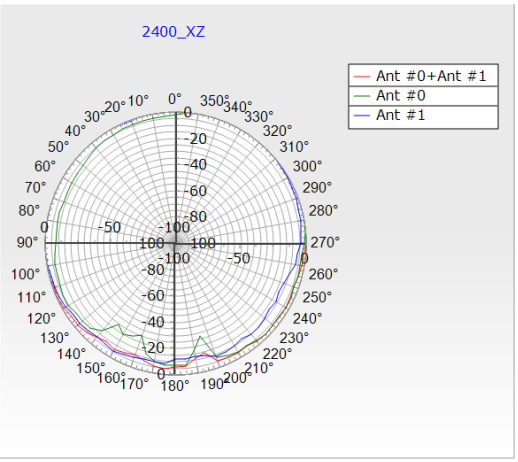
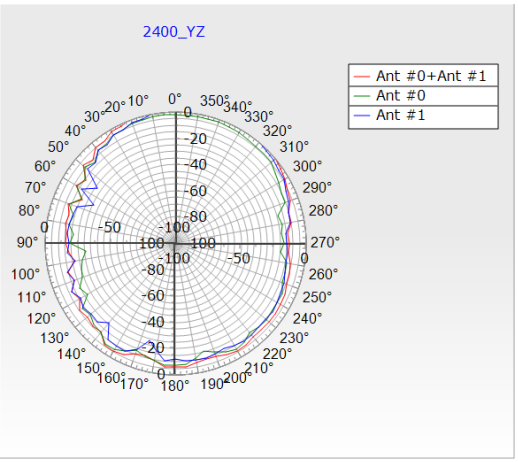
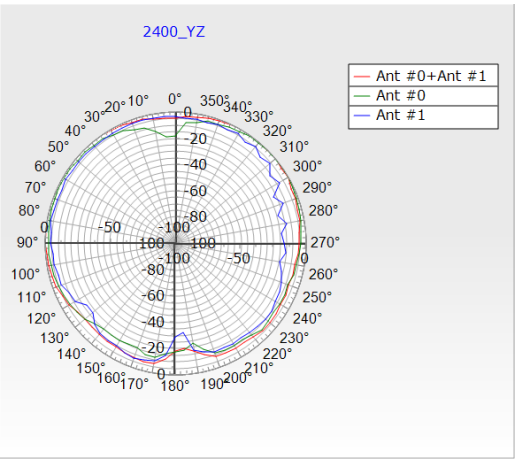
Note: NCR means No Calibration Required.

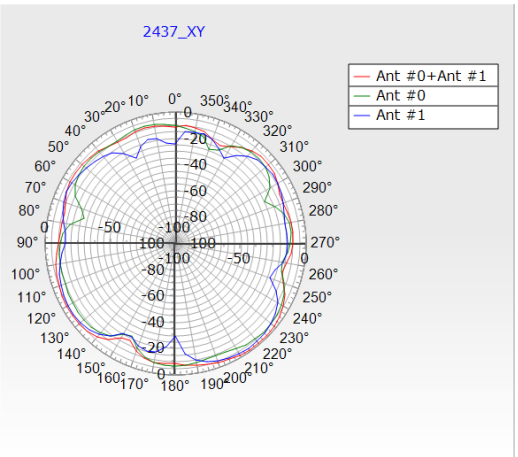
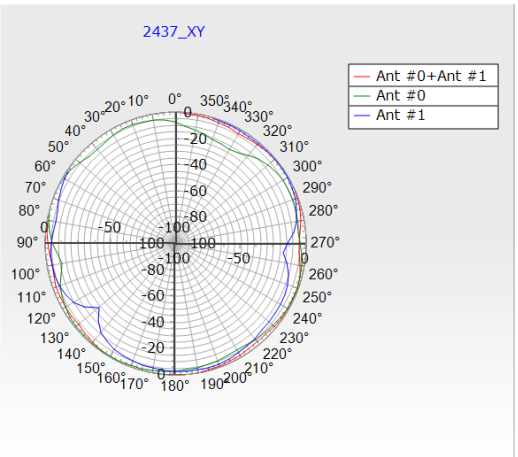
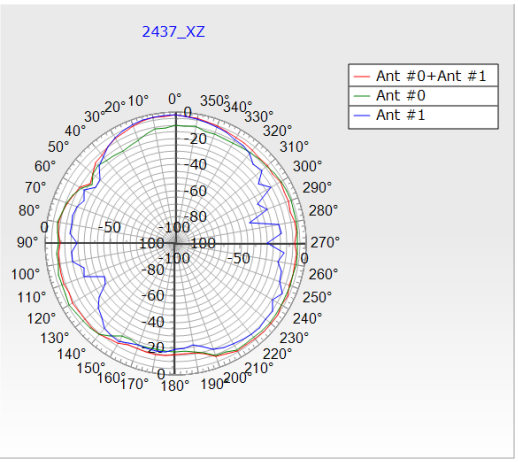
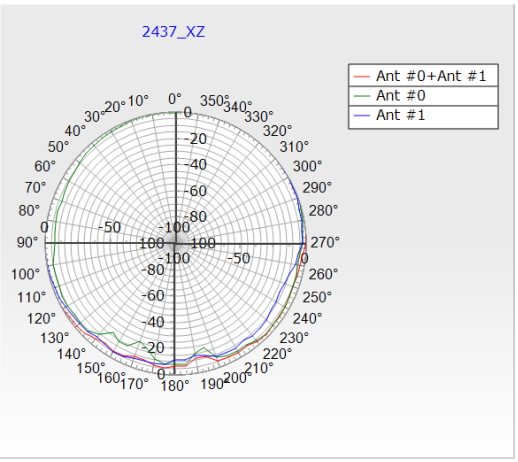
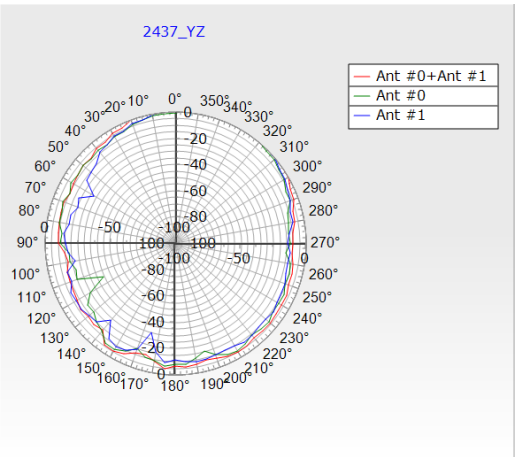
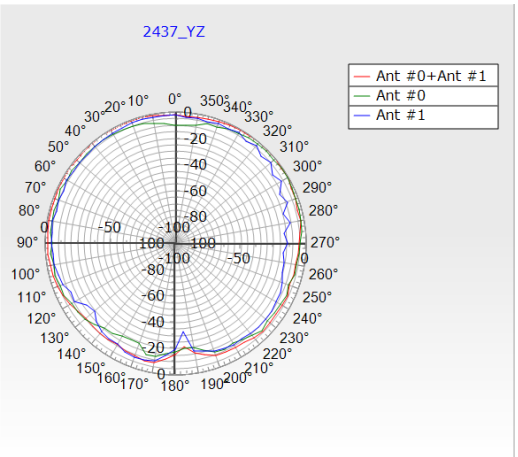
7. References

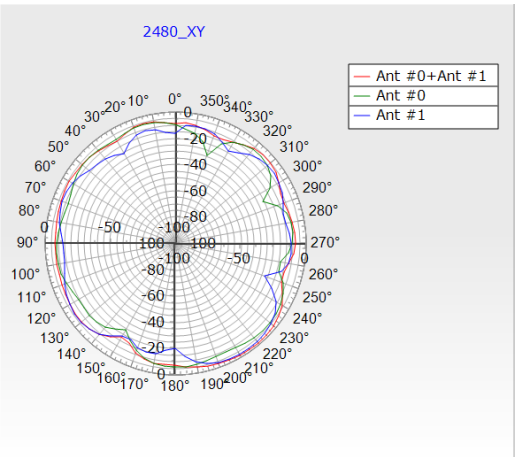
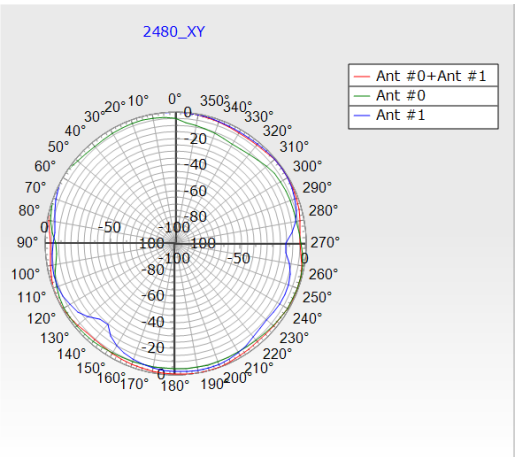
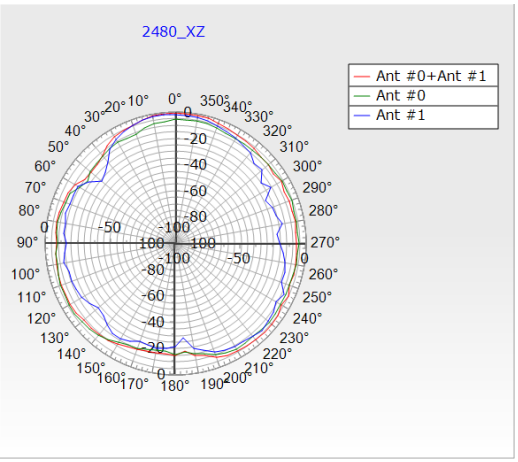
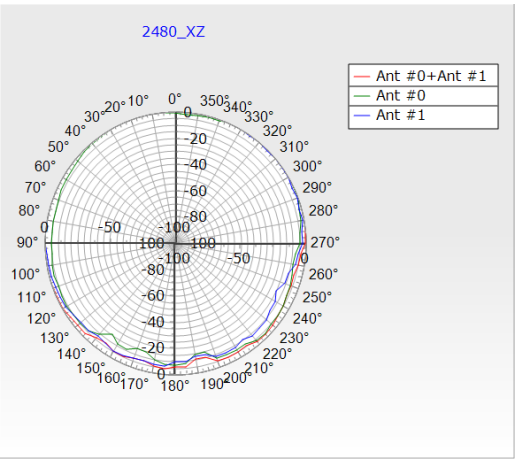
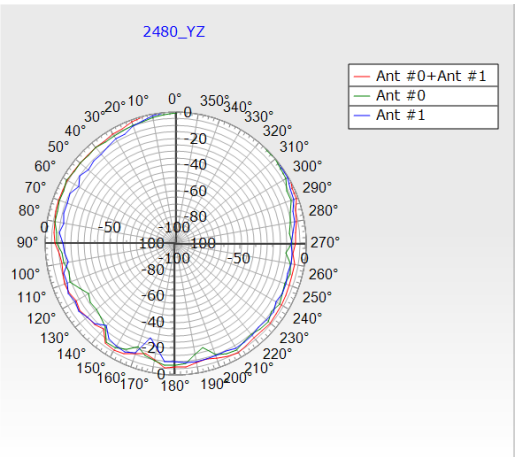
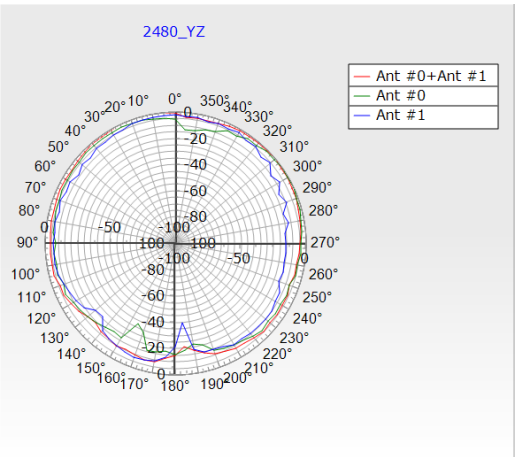
1. CTIA Test Plan for Wireless Device Over-the-Air Performance Version 3.7
2. FCC KDB 662911 D01 MIMO Antenna Gain Measurement

Appendix A. 2D Patterns

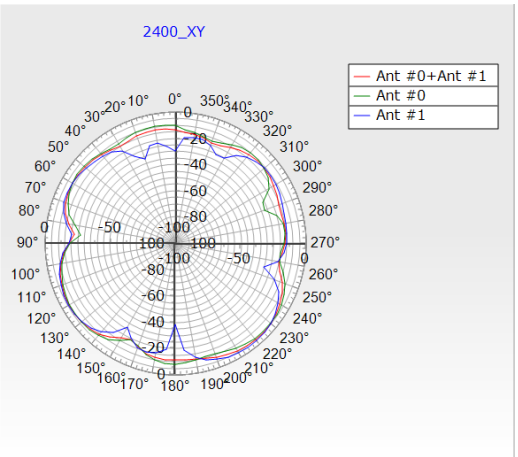
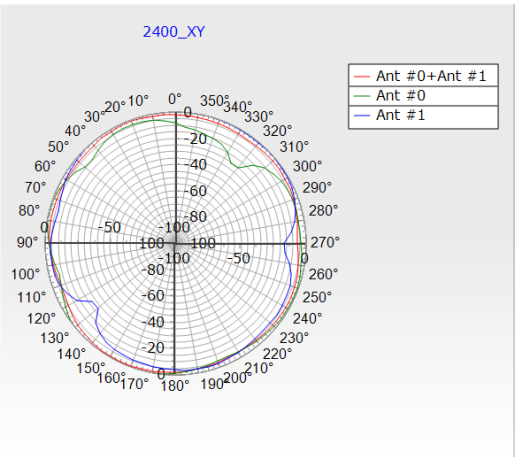
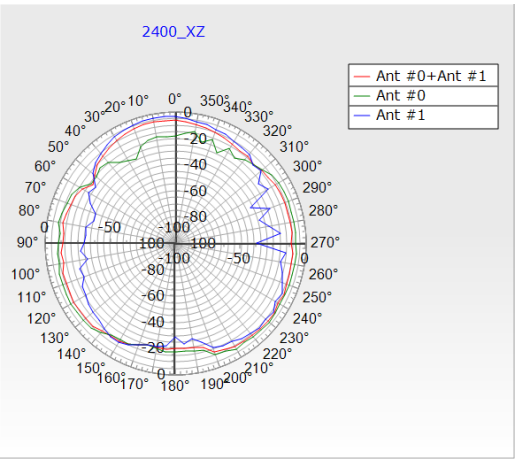
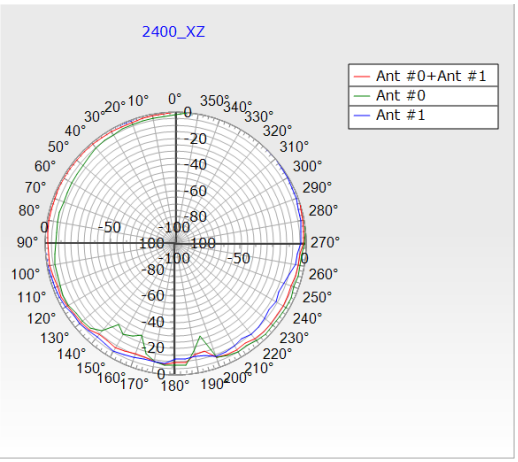
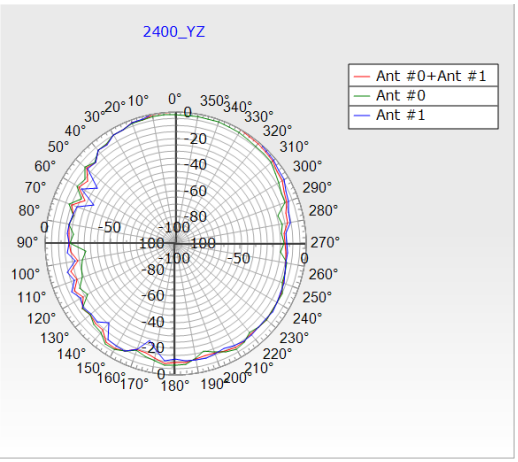
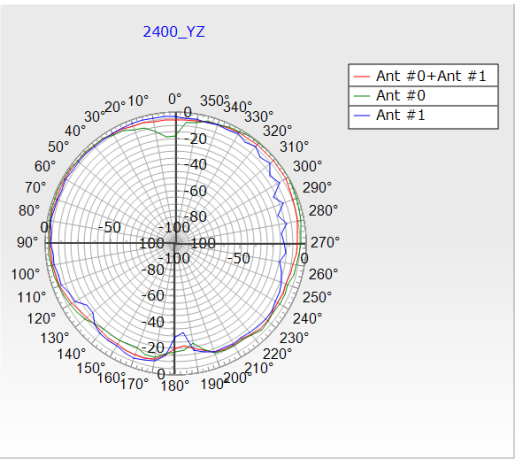
2.4GHz Ant #0, Ant #1 and Ant (#0 + #1)_Corr. DG:

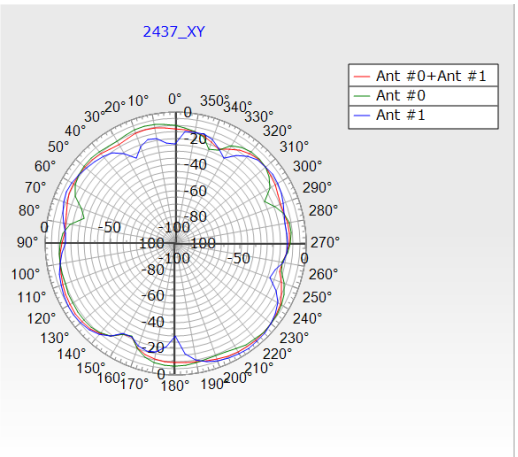
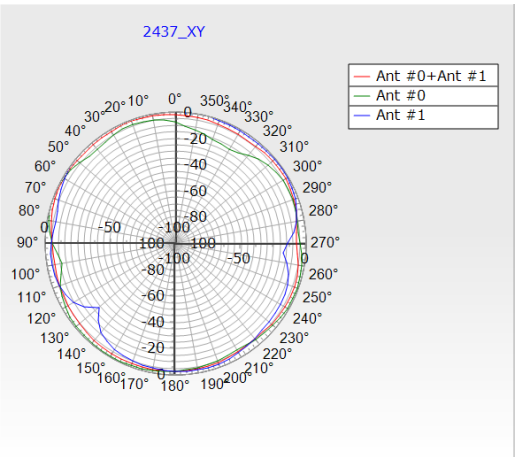
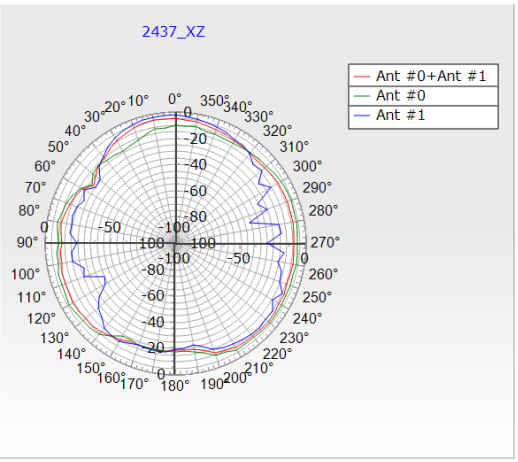
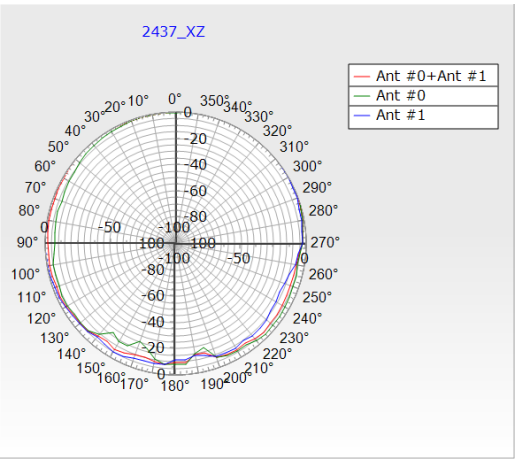
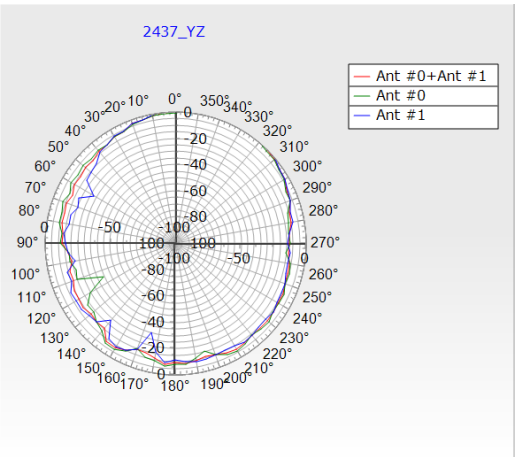
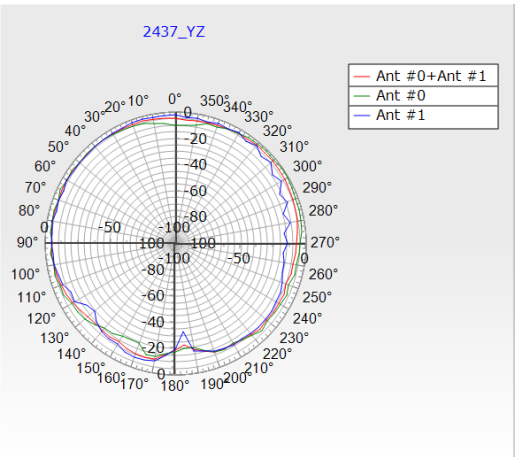
Phi_2400MHz	Theta _2400MHz
	
	
	

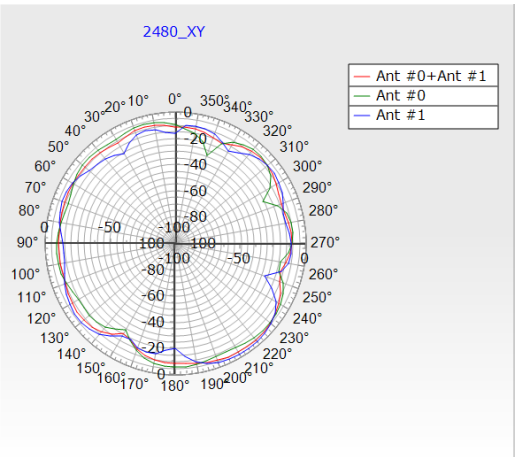
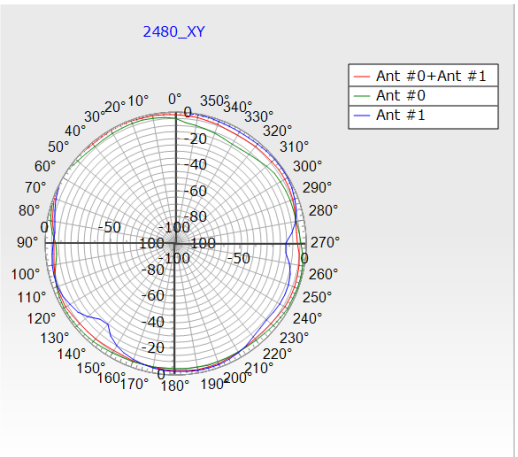
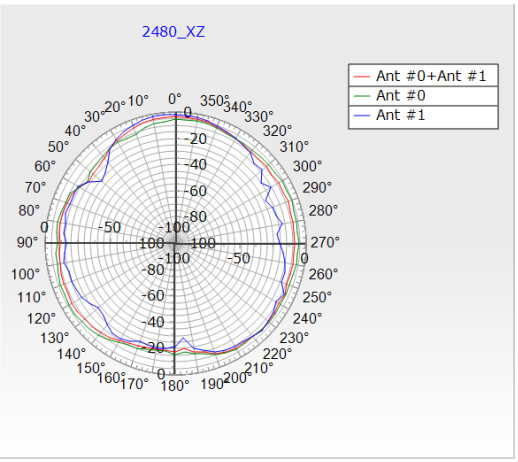
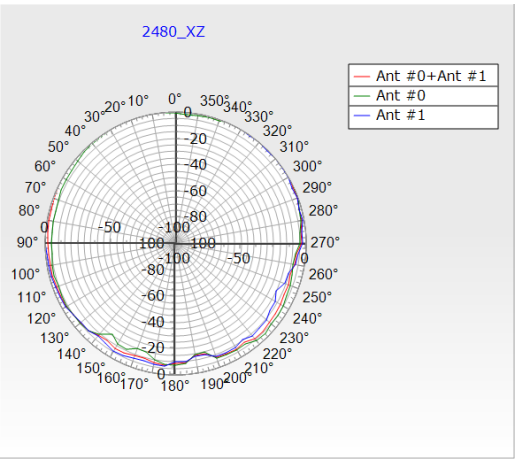
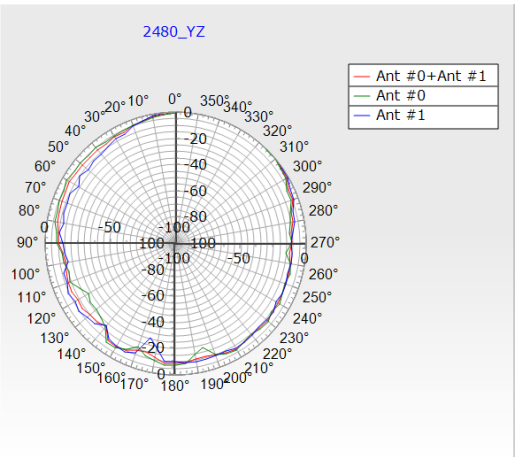
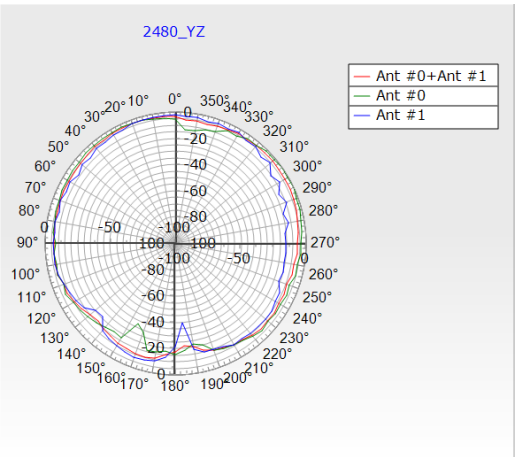
Phi_2437MHz	Theta _2437MHz
	
	
	

Phi_2480MHz	Theta _2480MHz
	
	
	

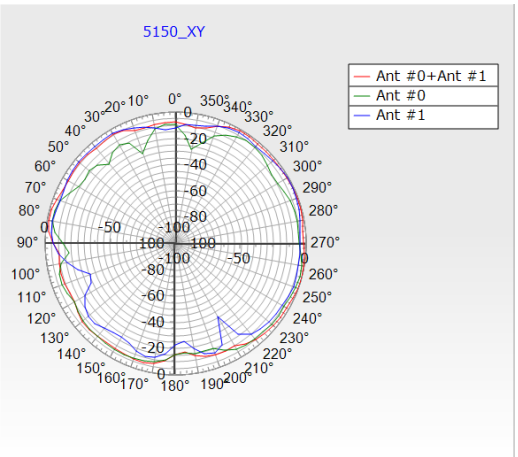
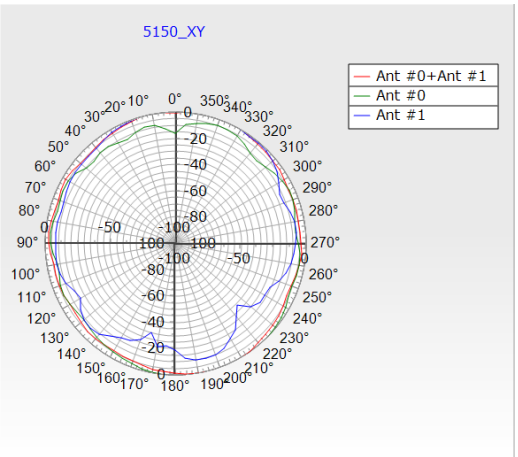
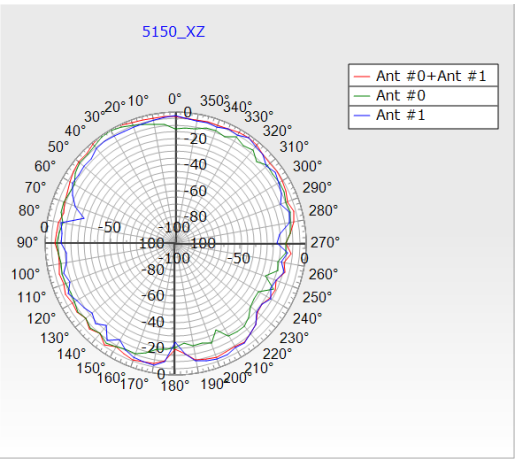
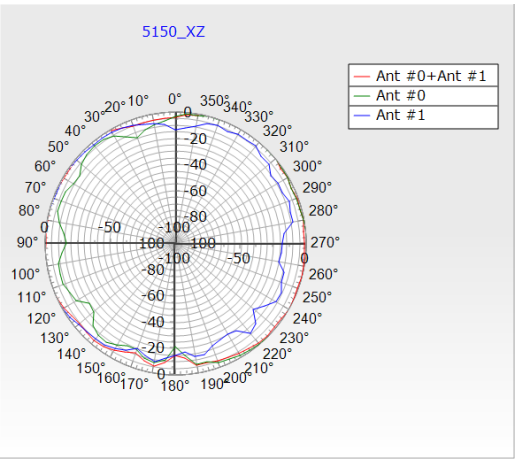
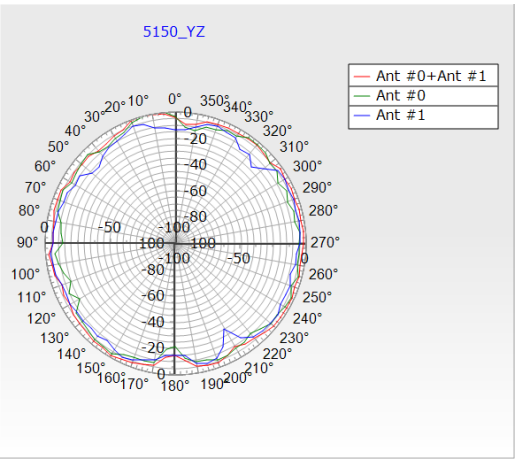
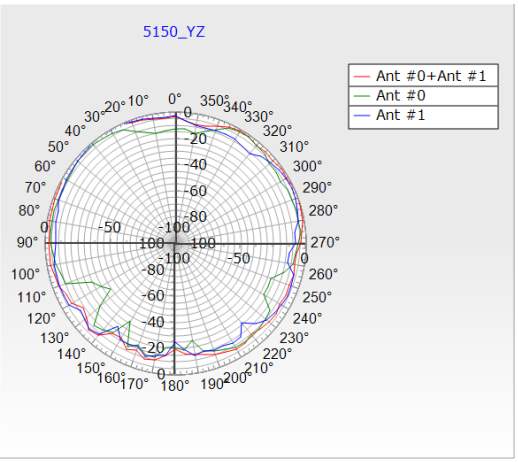
2.4GHz Ant #0, Ant #1 and Ant (#0 + #1)_Uncorr. DG:

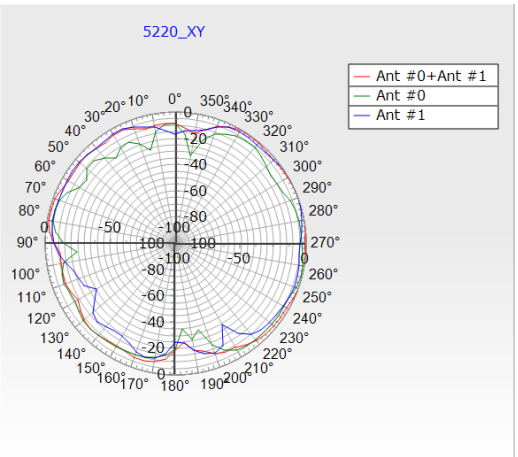
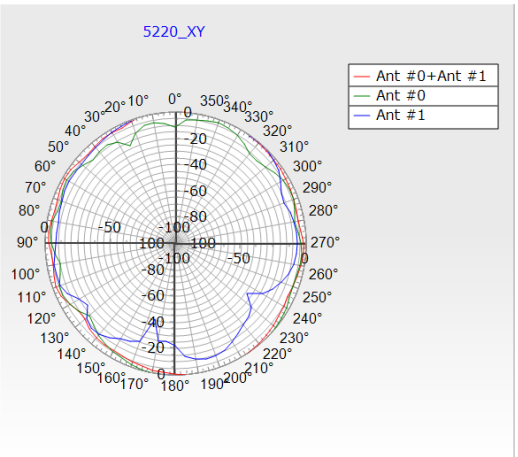
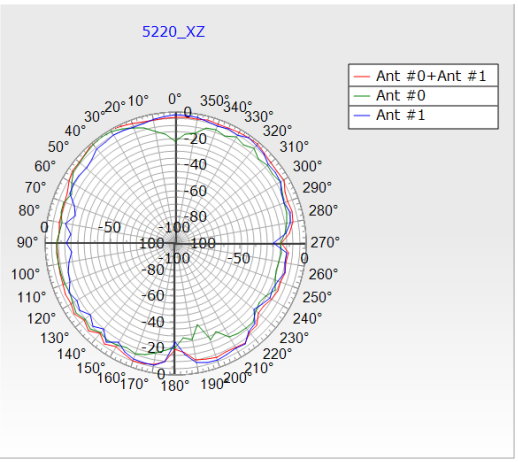
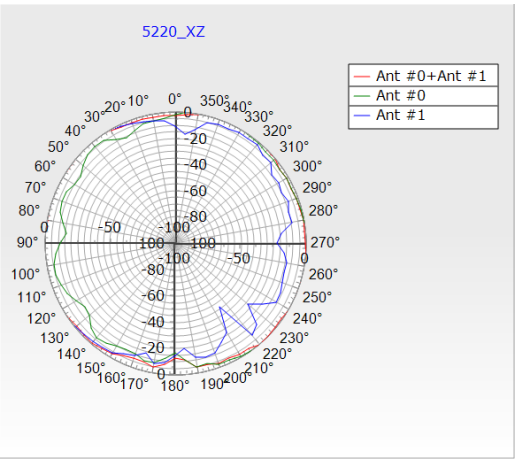
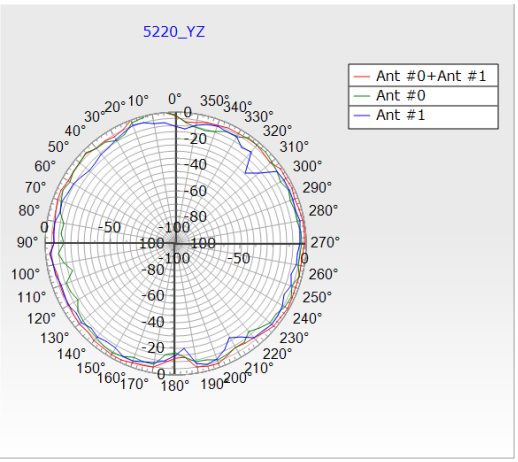
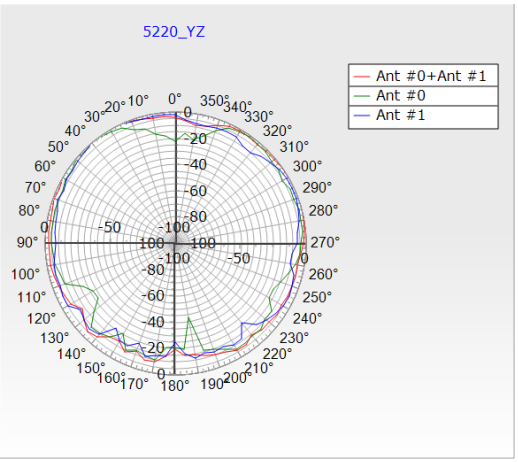
Phi_2400MHz	Theta _2400MHz
	
	
	

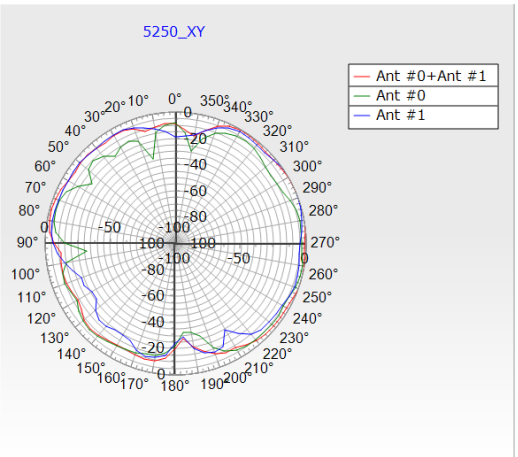
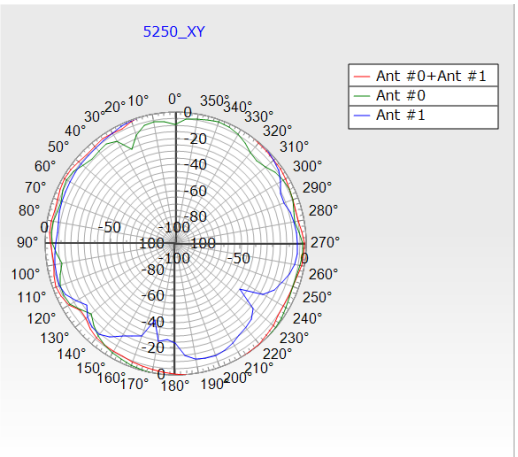
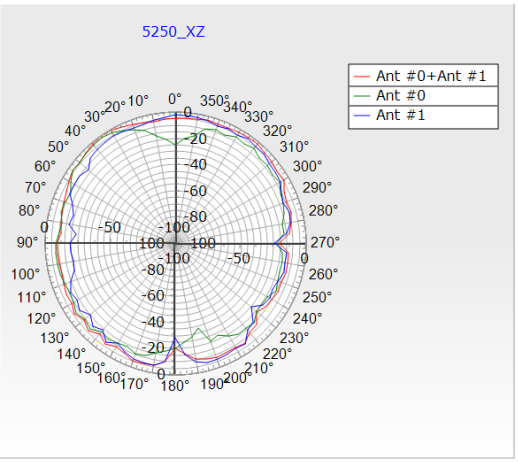
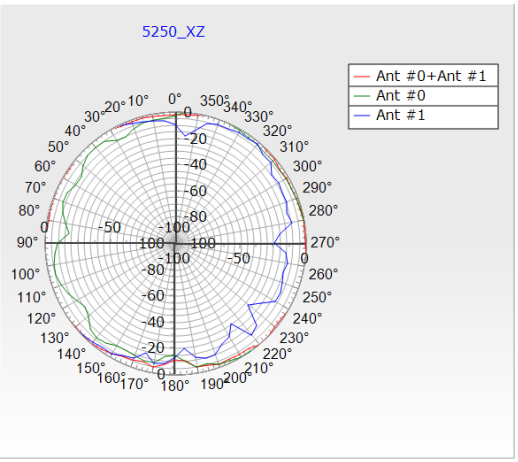
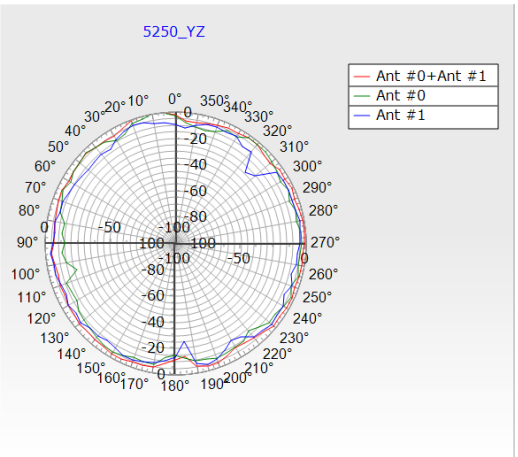
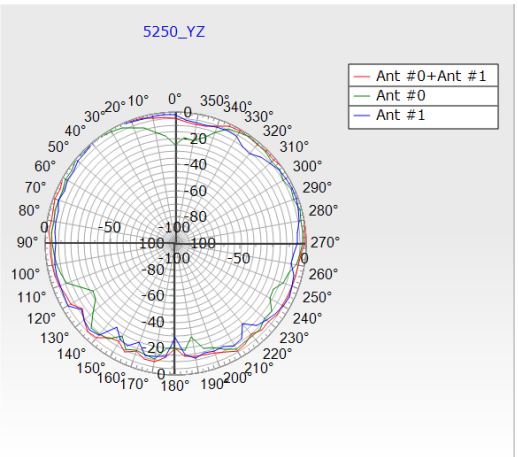
Phi_2437MHz	Theta _2437MHz
	
	
	

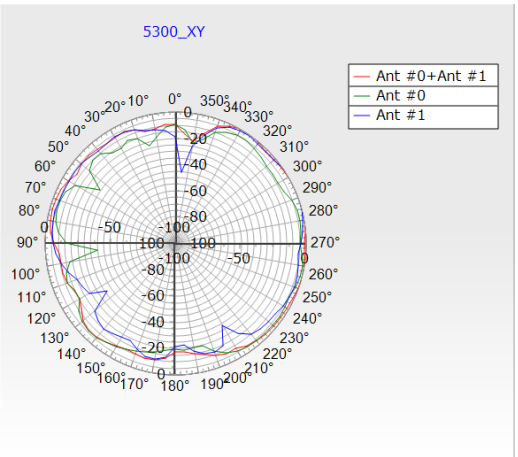
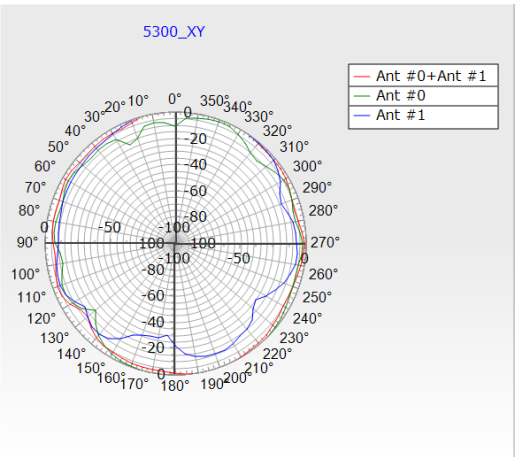
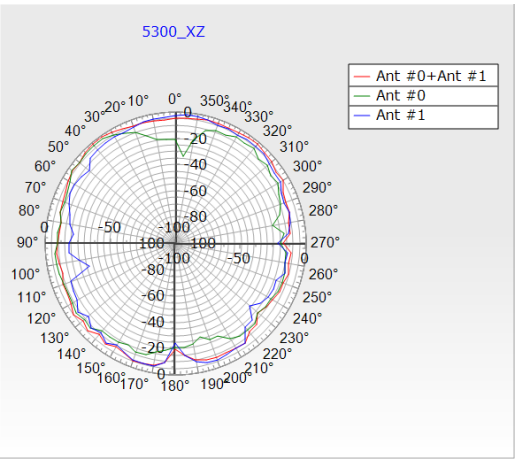
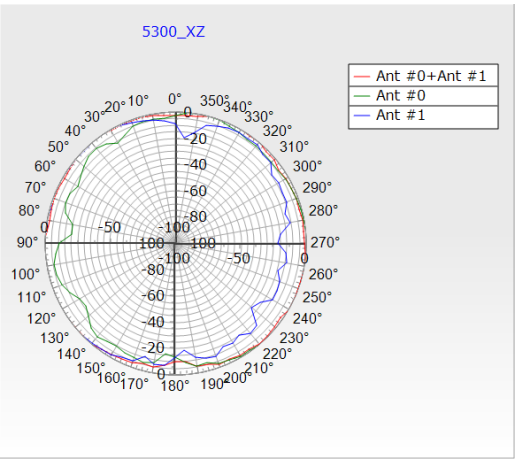
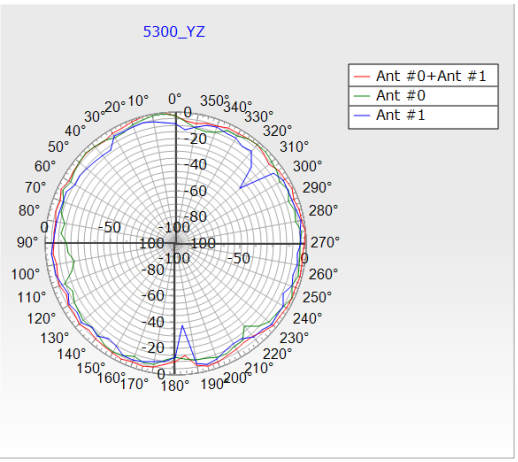
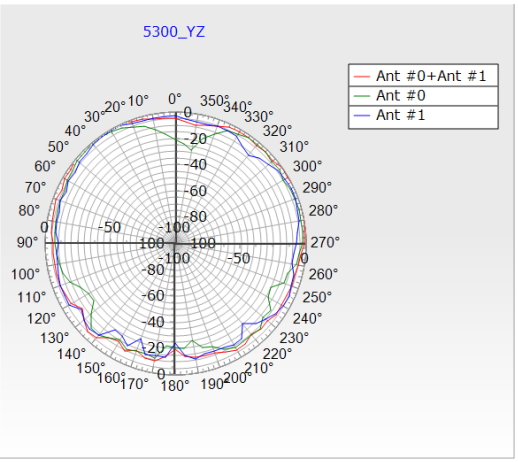
Phi_2480MHz	Theta _2480MHz
	
	
	

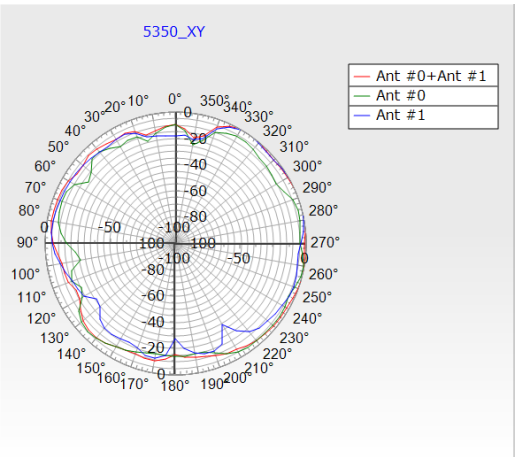
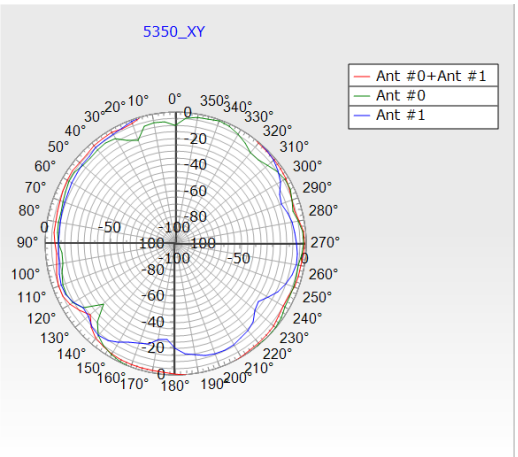
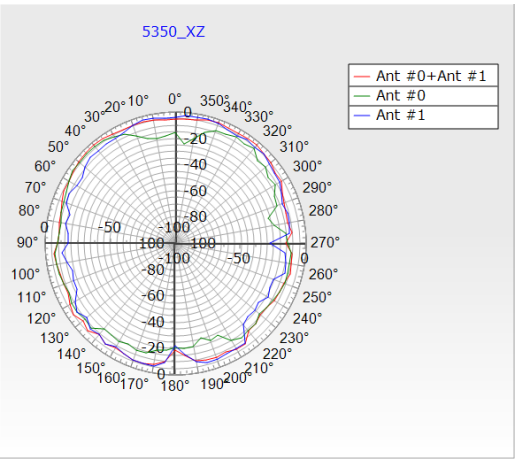
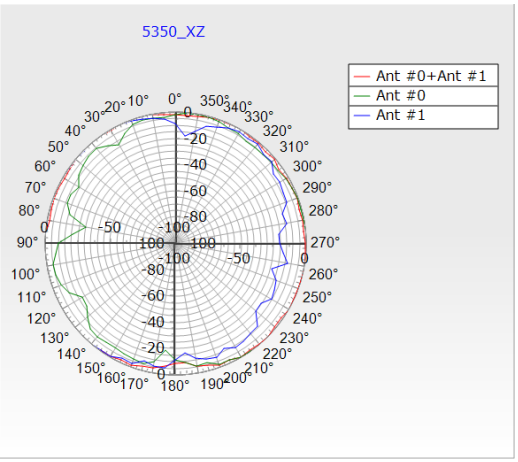
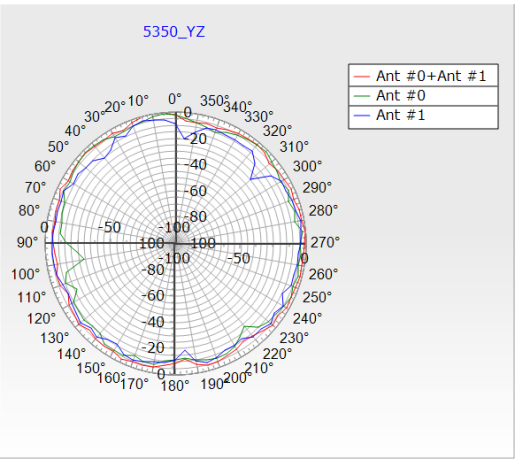
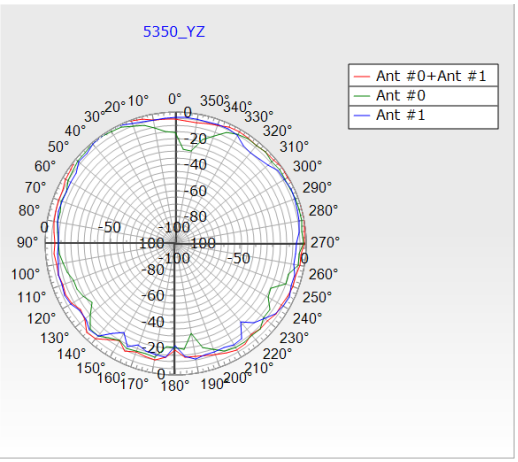
5GHz Ant #0, Ant #1 and Ant (#0 + #1)_Corr. DG:

Phi_5150MHz	Theta _5150MHz
	
	
	

Phi_5220MHz	Theta _5220MHz
	
	
	

Phi_5250MHz	Theta _5250MHz
	
	
	

Phi_5300MHz	Theta _5300MHz
	
	
	

Phi_5350MHz	Theta _5350MHz
	
	
	

Phi_5470MHz	Theta _5470MHz