

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
Model Name	L1LA10
Applicant	Kuiper Systems LLC
Manufacturer	Kuiper Systems 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 (°C / %)	Test Date
Radiated	Emma Zhou	24~25 / 30~36	Jul. 02 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 Ant1/5GHz Ant0)	Luxshare-ICT	833-00055	Dipole	UFL
Antenna #1 (WLAN 2.4GHz Ant0 /5GHz Ant1)	Luxshare-ICT	833-00056	Dipole	UFL

5. Test Results:

5.1 Individual Antenna Gain

Maximum Antenna Gains of Individual Antennas				
Antenna	Frequency (MHz)	Antenna gain (dBi)	Theta	Phi
#0	2400MHz	3.87(dBi)	20	340
#0	2437MHz	3.78(dBi)	10	345
#0	2480MHz	3.68(dBi)	5	335
#0	5150MHz	4.24(dBi)	90	240
#0	5220MHz	4.44(dBi)	90	240
#0	5250MHz	4.88(dBi)	90	240
#0	5300MHz	4.66(dBi)	90	240
#0	5350MHz	4.59(dBi)	90	240
#0	5470MHz	4.05(dBi)	75	255
#0	5580MHz	3.76(dBi)	125	290
#0	5725MHz	3.98(dBi)	95	245
#0	5785MHz	4.26(dBi)	95	250
#0	5850MHz	3.88(dBi)	85	255
#0	5865MHz	3.67(dBi)	85	255
#0	5895MHz	3.3(dBi)	80	260
#1	2400MHz	0.51(dBi)	60	335
#1	2437MHz	0.38(dBi)	90	120
#1	2480MHz	1.15(dBi)	85	115
#1	5150MHz	3.6(dBi)	65	170
#1	5220MHz	3.61(dBi)	65	175
#1	5250MHz	3.73(dBi)	70	180
#1	5300MHz	3.36(dBi)	60	175
#1	5350MHz	3.18(dBi)	60	180
#1	5470MHz	3.56(dBi)	80	175
#1	5580MHz	4.32(dBi)	75	175
#1	5725MHz	2.82(dBi)	50	315
#1	5785MHz	3.17(dBi)	50	315
#1	5850MHz	3.62(dBi)	50	315
#1	5865MHz	3.5(dBi)	50	320
#1	5895MHz	3.55(dBi)	50	320

Maximum Antenna Gains of Individual Antennas for Elevation Angle above 30 Degrees				
Antenna	Frequency (MHz)	Antenna gain (dBi)	Theta	Phi
#0	5150MHz	4.24(dBi)	90	240
#0	5220MHz	4.44(dBi)	90	240
#0	5250MHz	4.88(dBi)	90	240
#1	5150MHz	3.6(dBi)	65	170
#1	5220MHz	3.61(dBi)	65	175
#1	5250MHz	3.73(dBi)	70	180

5.2 Directional Antenna Gain

Directional gains						
Frequency (MHz)	2400	2437	2480			
Ant. #0 Gain (dBi)	3.78	3.58	3.06			
Ant. #1 Gain (dBi)	-1.03	-0.35	-0.27			
(Theta, Phi)	20,345	20,350	20,355			
Directional Gain - Correlated (dBi)	4.71	4.85	4.56			
Ant. #0 Gain (dBi)	3.78	3.7	3.26			
Ant. #1 Gain (dBi)	-1.03	-0.59	-0.65			
(Theta, Phi)	20,345	20,345	15,345			
Directional Gain - Uncorrelated (dBi)	2.01	2.06	1.73			
Frequency (MHz)	5150	5220	5250	5300	5350	5470
Ant. #0 Gain (dBi)	1.53	-0.14	0.5	-2.01	-1.53	-0.82
Ant. #1 Gain (dBi)	2.19	2.22	1.9	3.03	3.08	3.42
(Theta, Phi)	95,75	95,70	125,215	90,190	75,185	75,170
Directional Gain - Correlated (dBi)	4.88	4.13	4.24	3.88	4.09	4.57
Ant. #0 Gain (dBi)	1.53	4.44	4.88	4.66	4.59	-0.82
Ant. #1 Gain (dBi)	2.19	-6.86	-6.73	-7.65	-6.92	3.42
(Theta, Phi)	95,75	90,240	90,240	90,240	90,240	75,170
Directional Gain - Uncorrelated (dBi)	1.87	1.74	2.16	1.9	1.88	1.8
Frequency (MHz)	5580	5725	5785	5850	5865	5895
Ant. #0 Gain (dBi)	-0.01	0.5	4.26	0.56	0.53	0.33
Ant. #1 Gain (dBi)	4.25	1.82	-5.08	1.24	1.17	0.84
(Theta, Phi)	80,180	75,175	95,250	25,290	25,290	25,290
Directional Gain - Correlated (dBi)	5.39	4.2	3.8	3.92	3.87	3.6
Ant. #0 Gain (dBi)	-0.01	3.98	4.26	3.76	3.47	-12.97
Ant. #1 Gain (dBi)	4.25	-3.66	-5.08	-5.84	-6.27	3.55
(Theta, Phi)	80,180	95,245	95,250	95,250	95,250	50,320
Directional Gain - Uncorrelated (dBi)	2.62	1.66	1.73	1.2	0.9	0.64

Directional gains for Elevation Angle above 30 Degrees						
Frequency (MHz)	5150	5220	5250			
Ant. #0 Gain (dBi)	1.53	-0.14	0.5			
Ant. #1 Gain (dBi)	2.19	2.22	1.9			
(Theta, Phi)	95,75	95,70	125,215			
Directional Gain - Correlated (dBi)	4.88	4.13	4.24			
Ant. #0 Gain (dBi)	1.53	4.44	4.88			
Ant. #1 Gain (dBi)	2.19	-6.86	-6.73			
(Theta, Phi)	95,75	90,240	90,240			
Directional Gain - Uncorrelated (dBi)	1.87	1.74	2.16			

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 $G_1, G_2, \dots, G_N$ dBi

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

Directional gain = $10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{\text{ANT}}]$ 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.]

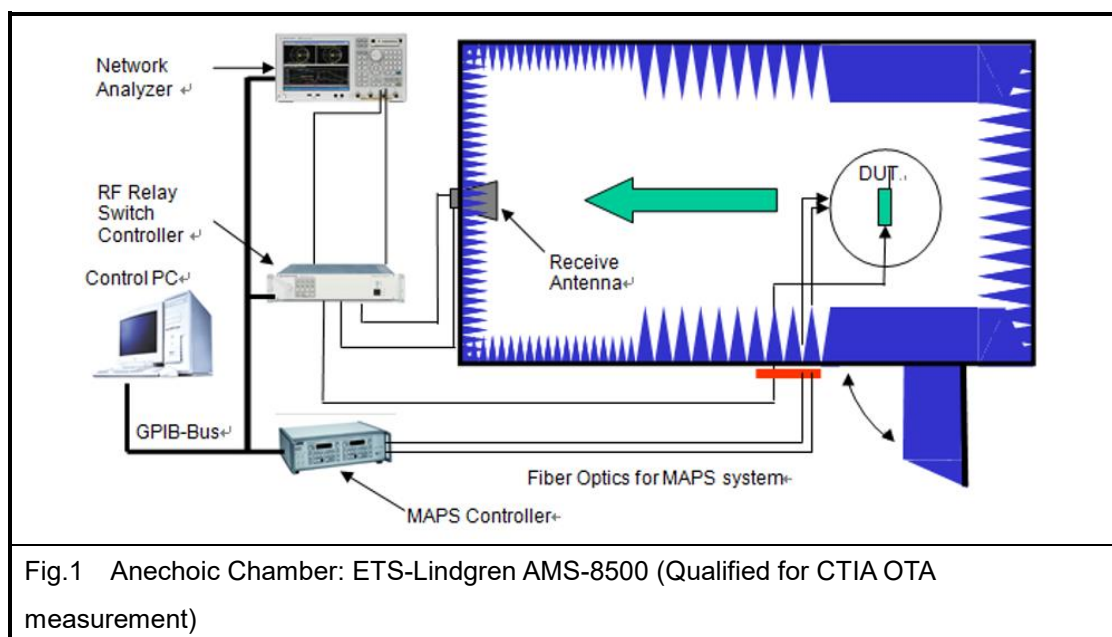
(ii) If all transmit signals are *completely uncorrelated*, then

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



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

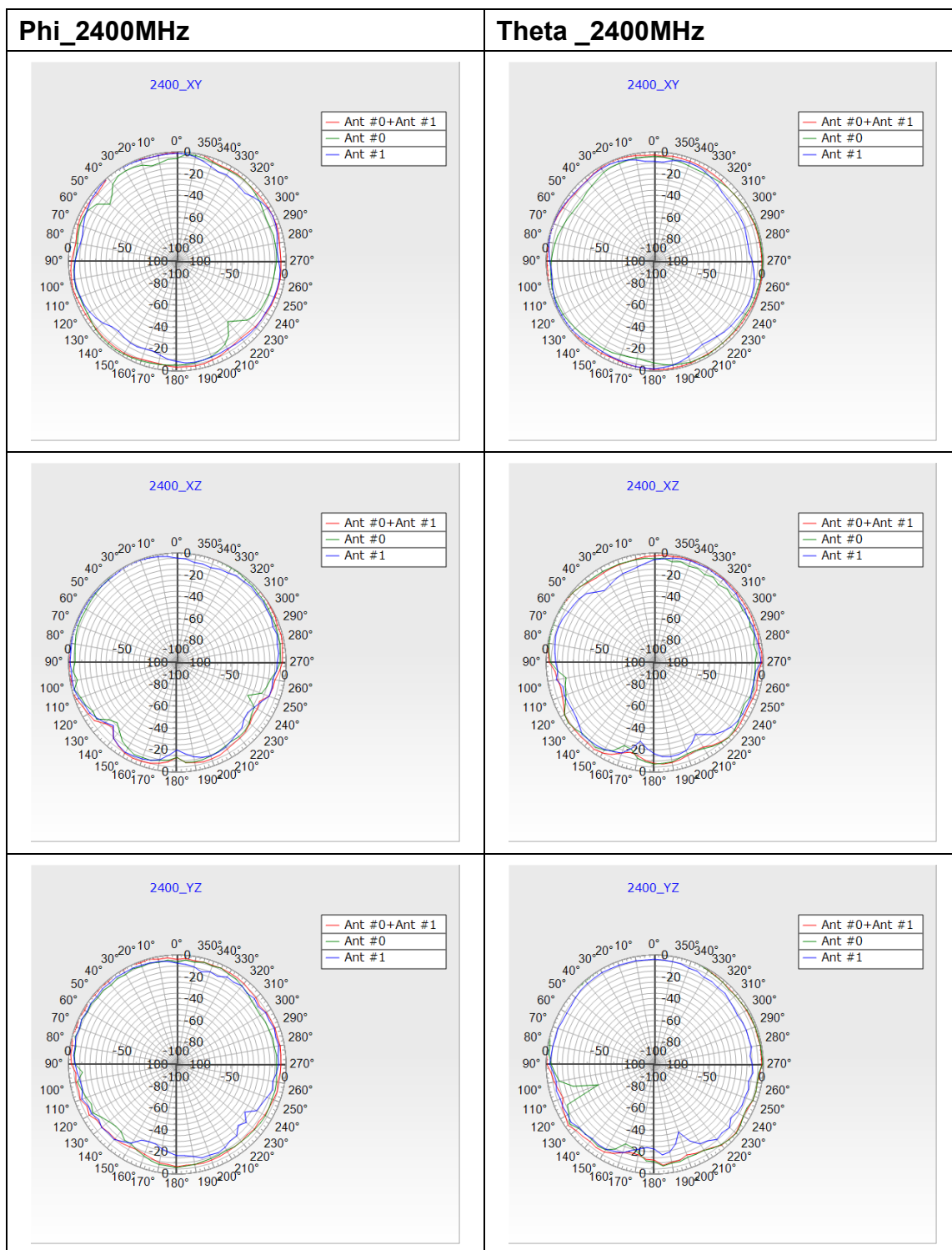
Note: NCR means No Calibration Required.

7. References

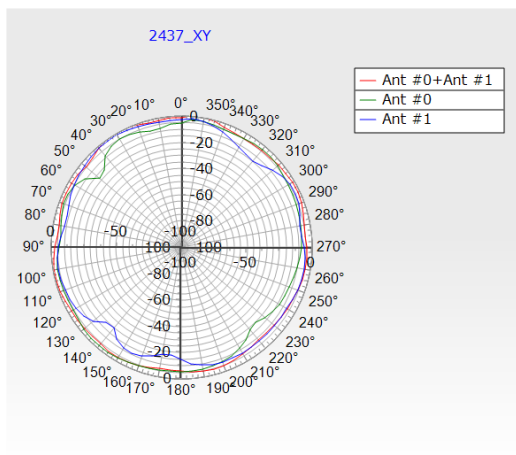
1. CTIA Test Plan for Wireless Device Over-the-Air Performance Version 3.7
2. FCC KDB 662911 D01 MIMO Antenna Gain Measurement

Appendix A. 2D Patterns

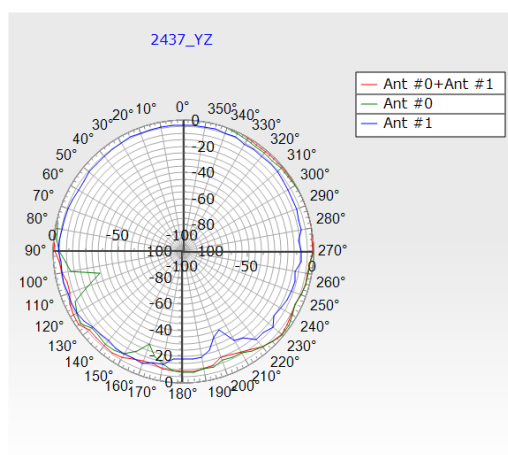
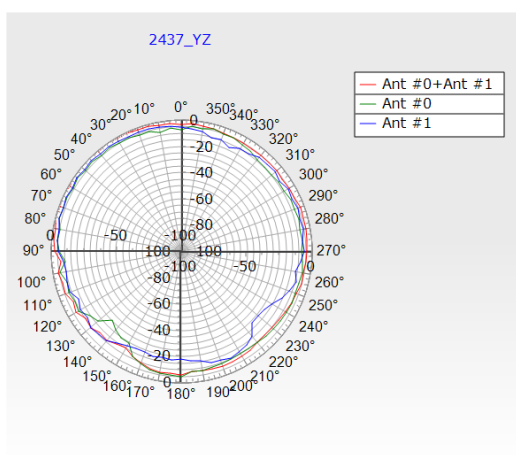
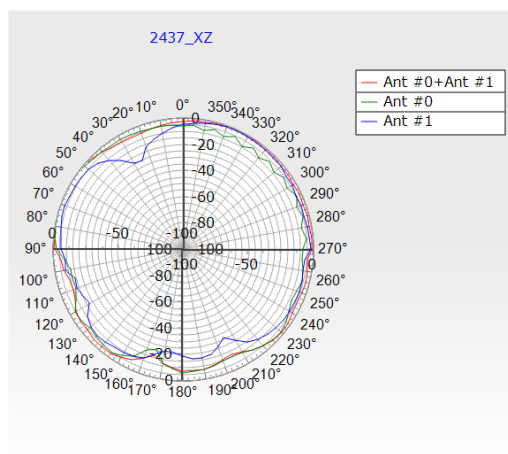
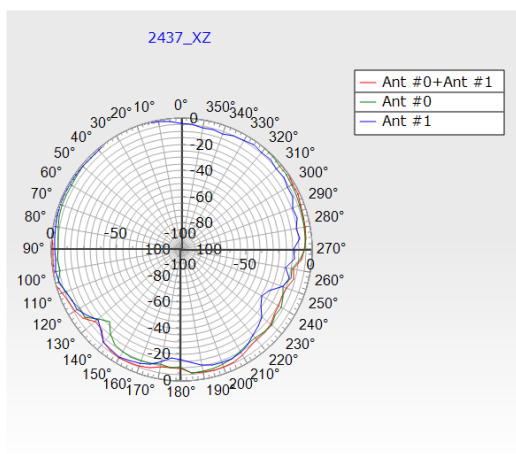
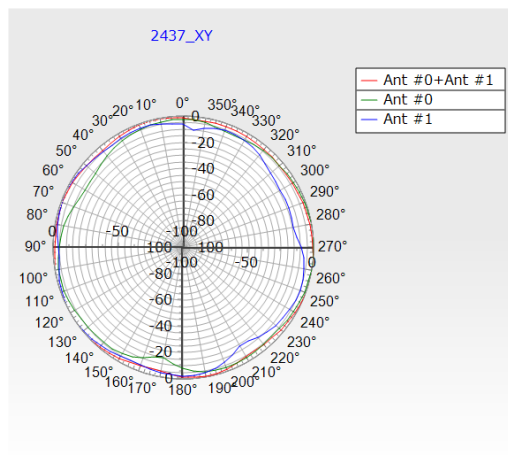
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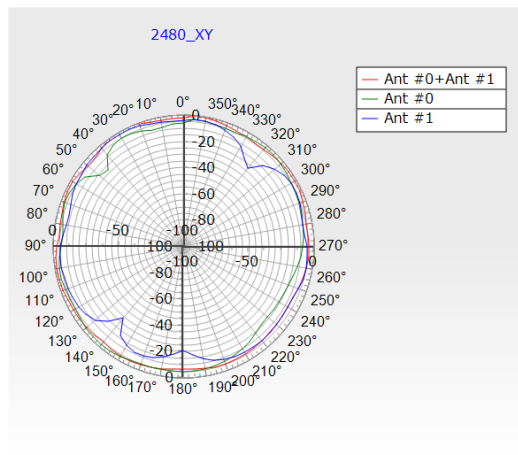
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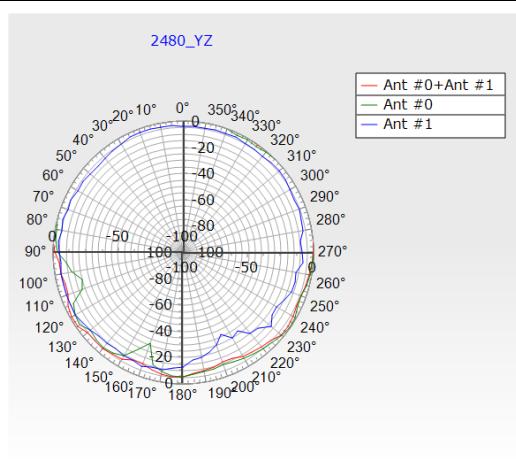
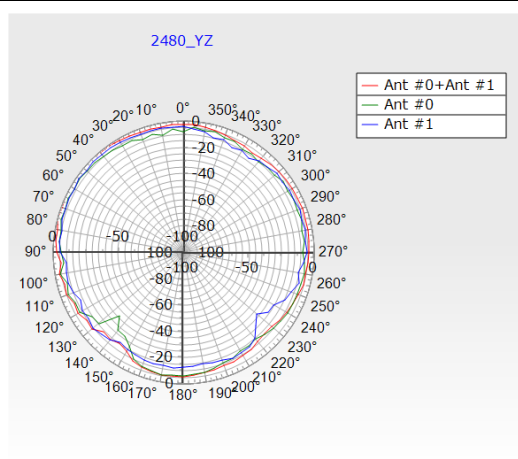
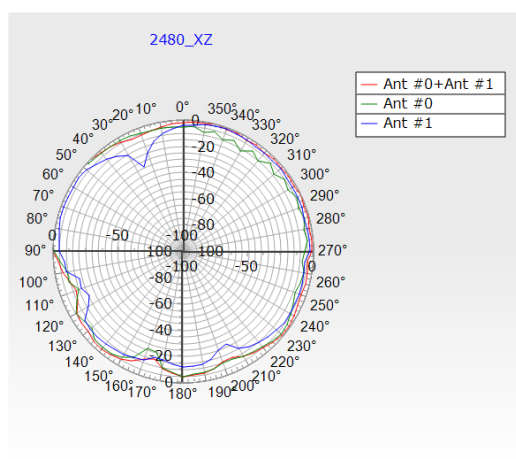
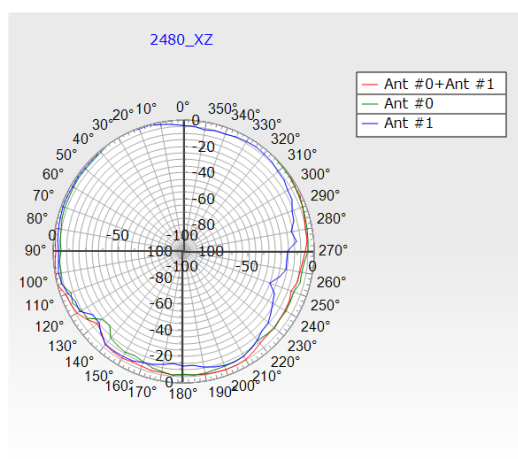
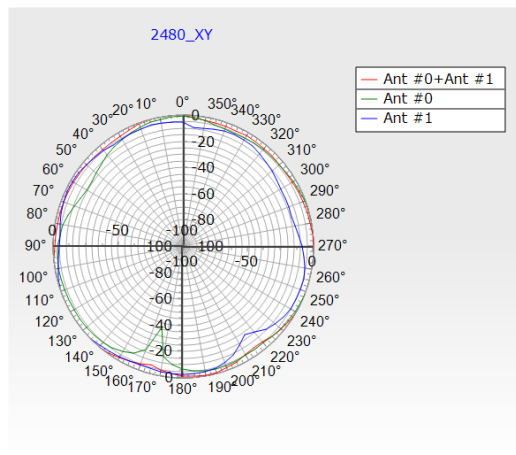
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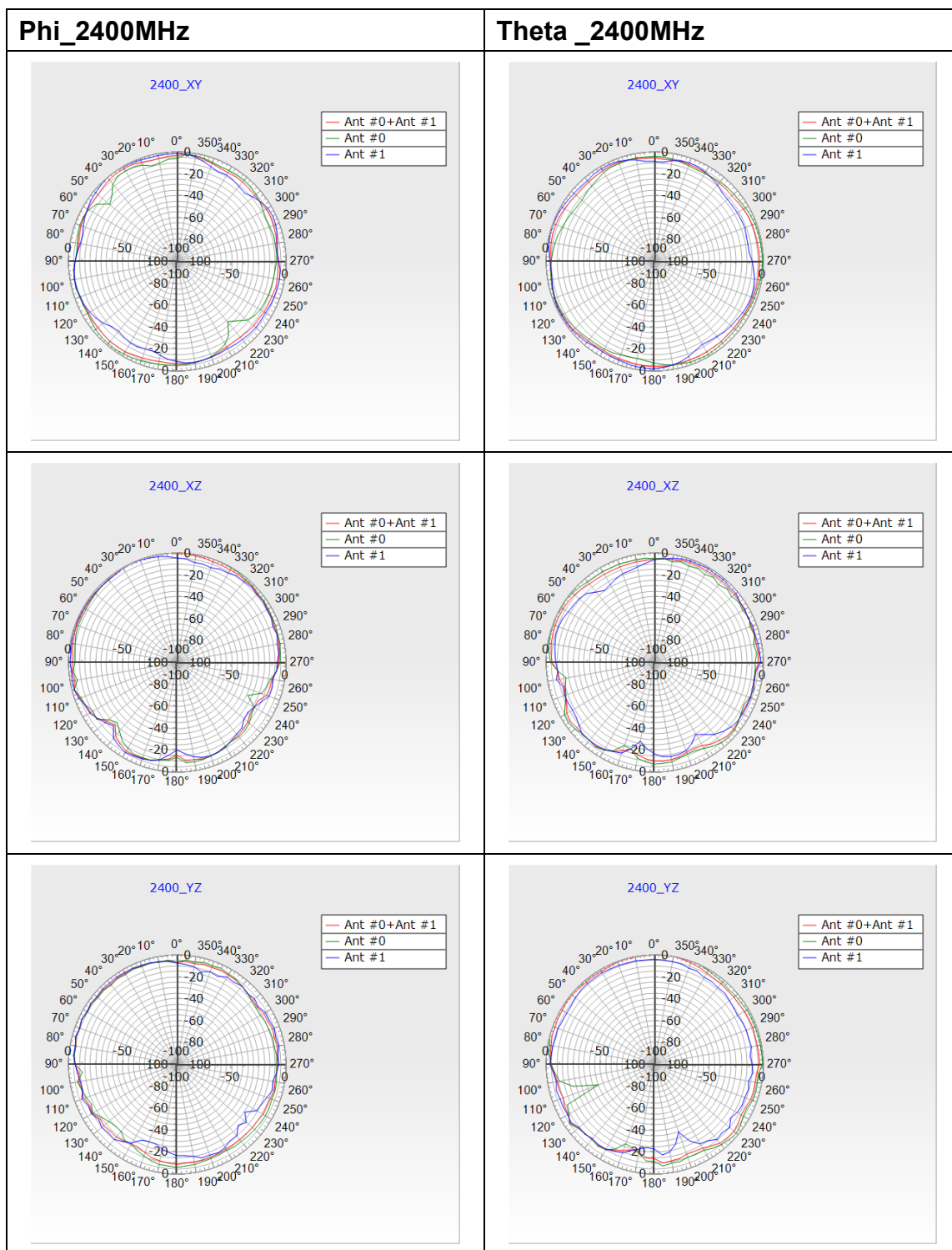
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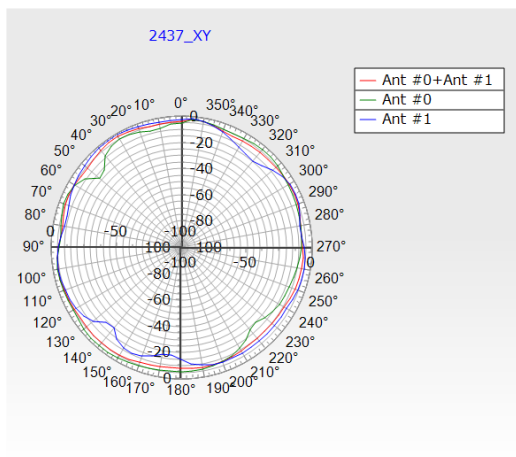
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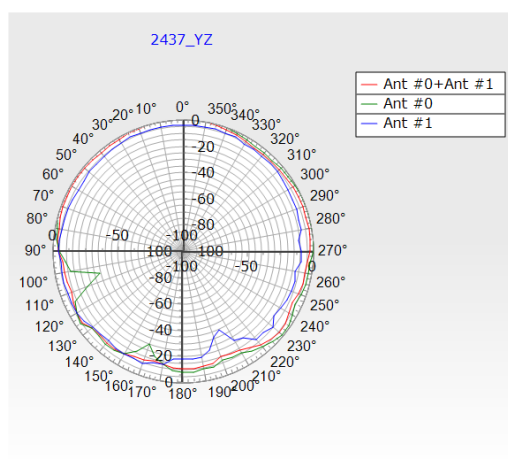
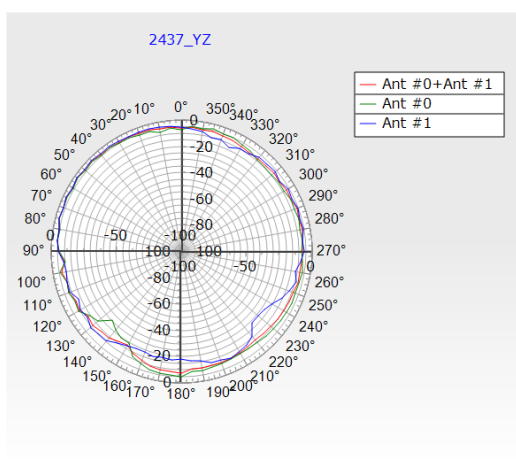
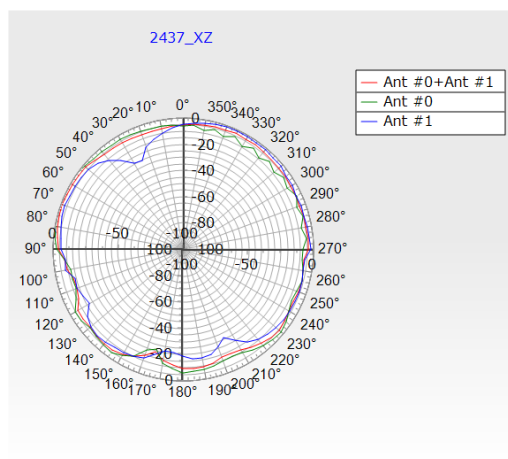
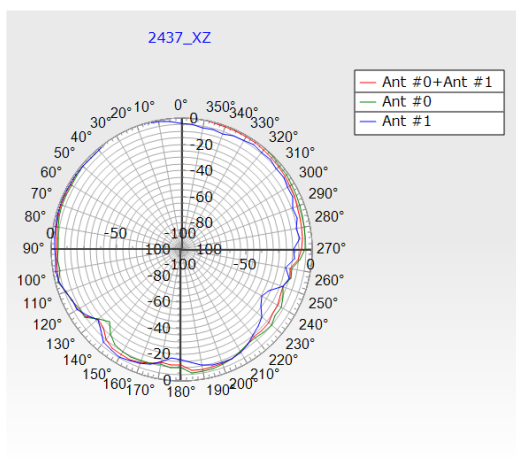
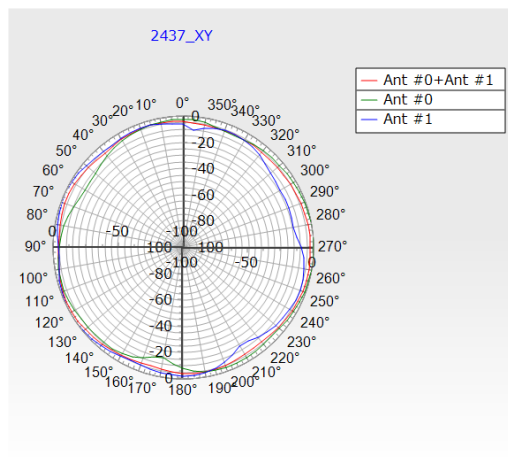
2.4GHz Ant #0, Ant #1 and Ant (#0 + #1)_Uncorr. DG:



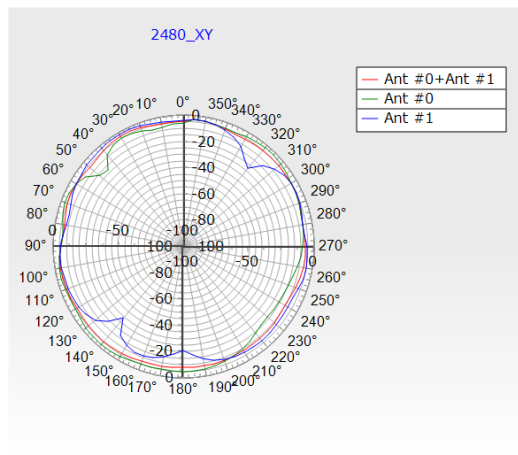
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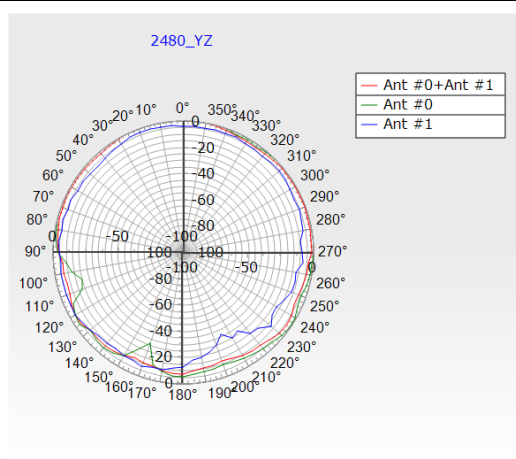
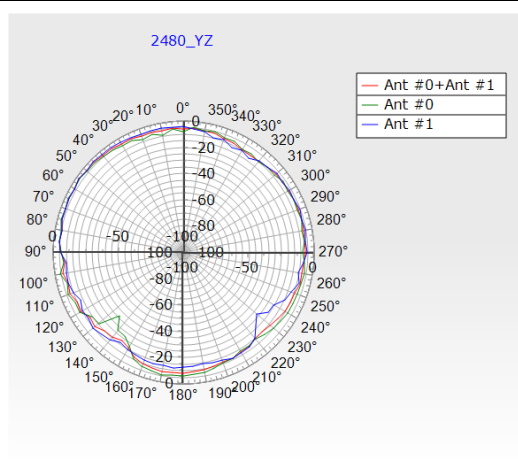
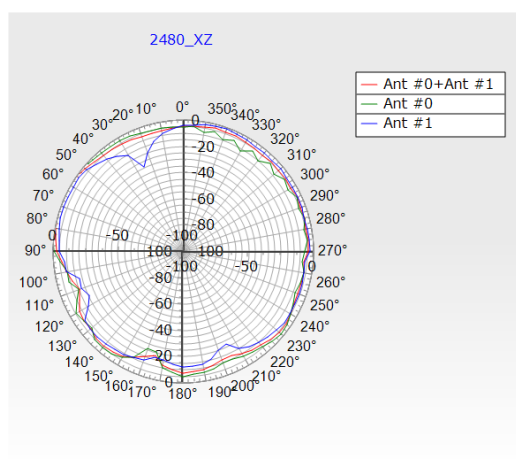
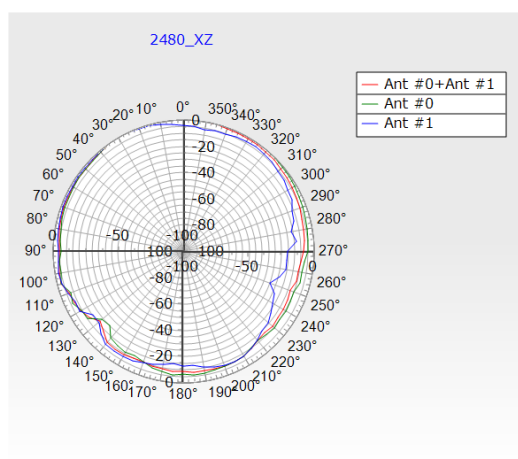
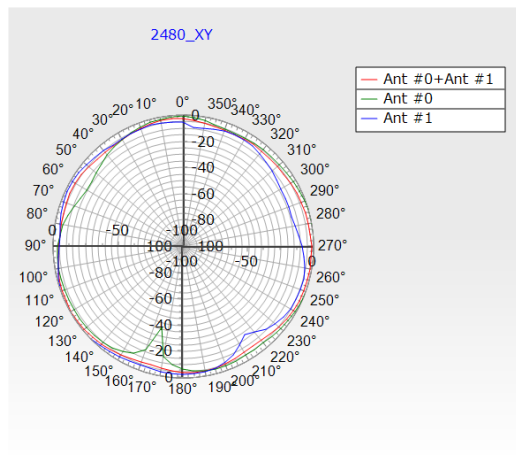
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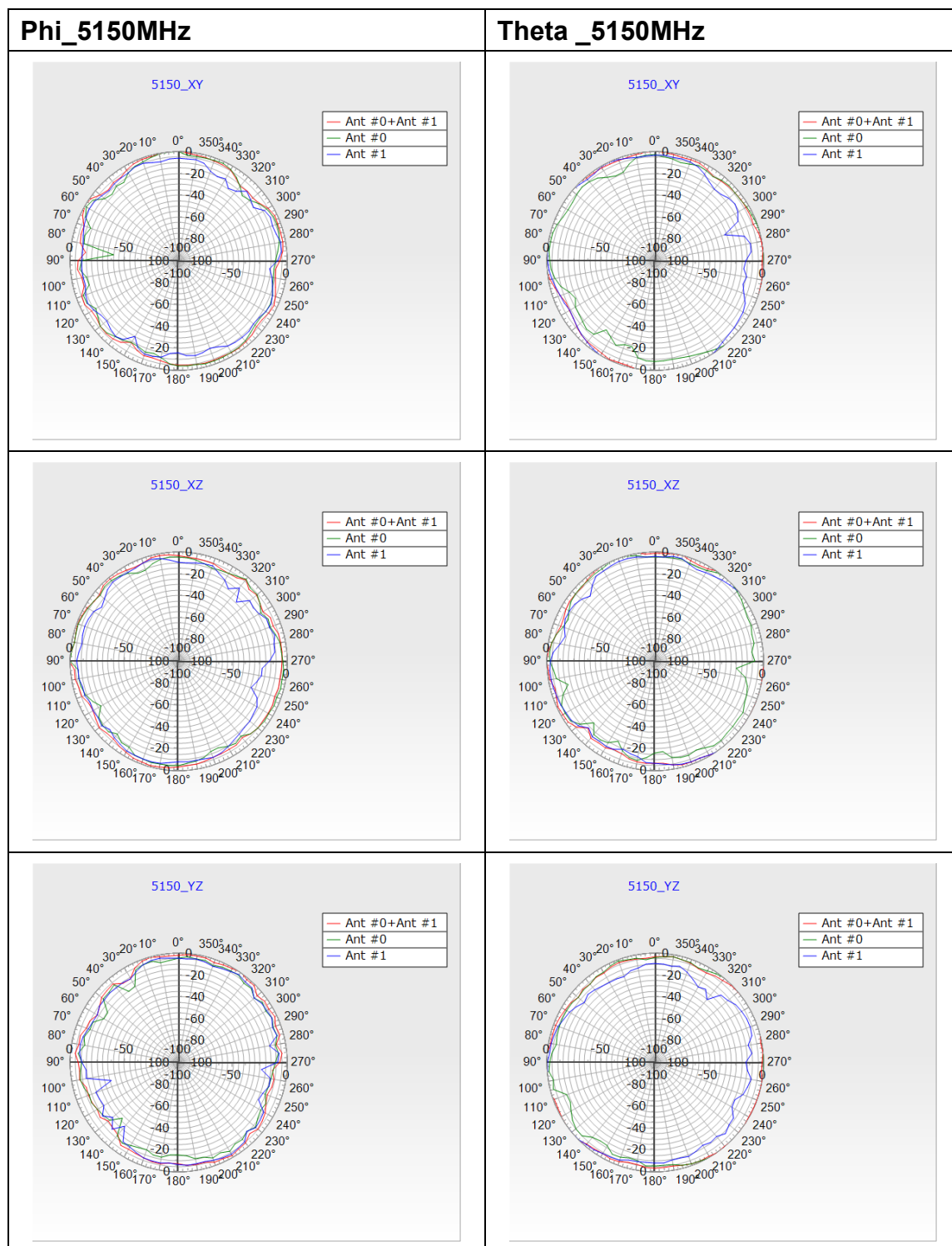
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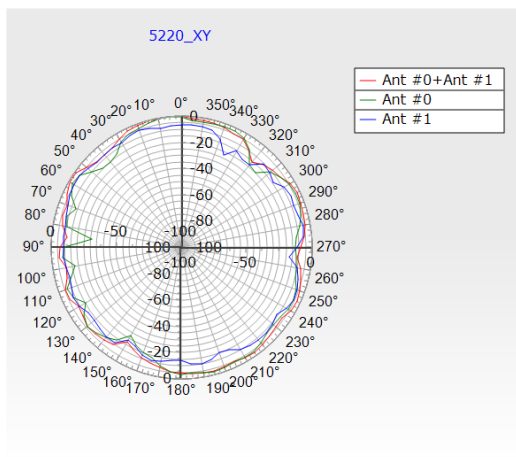
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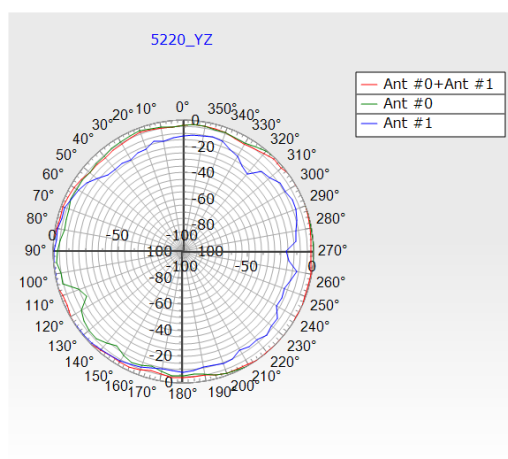
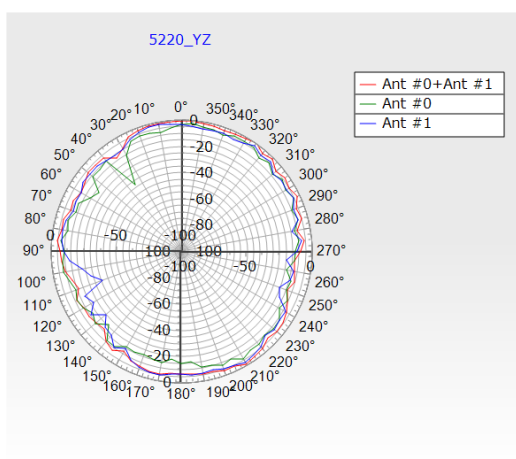
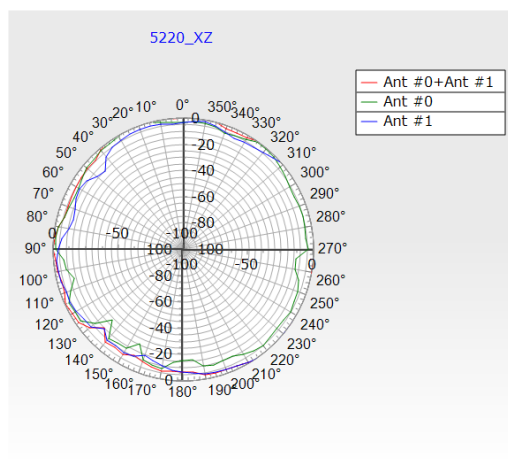
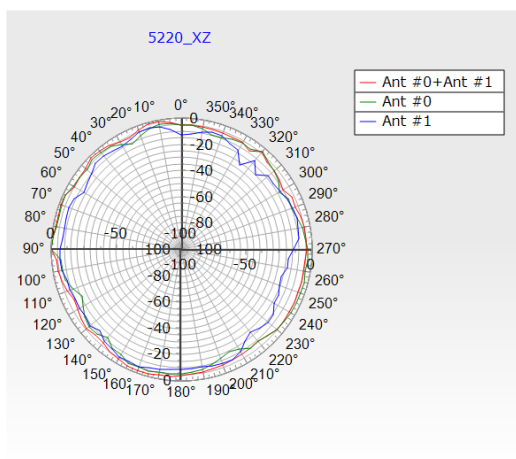
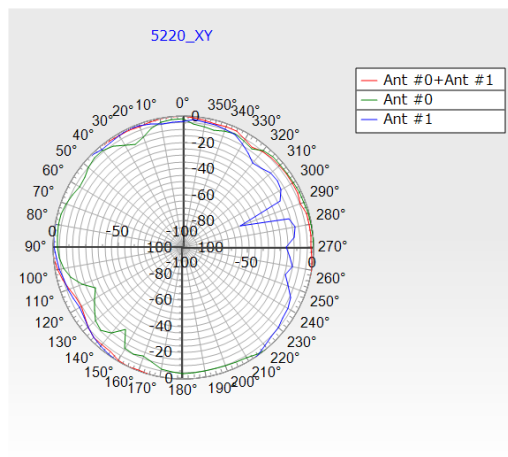
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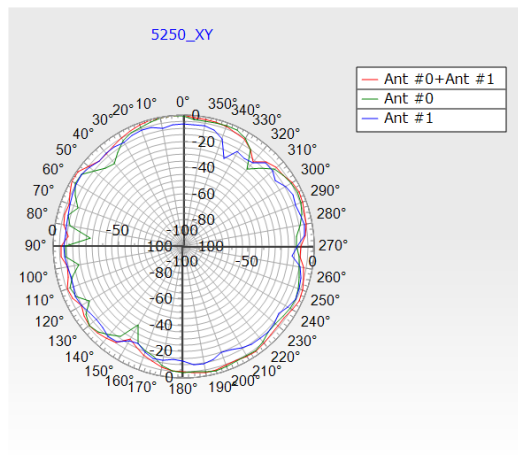
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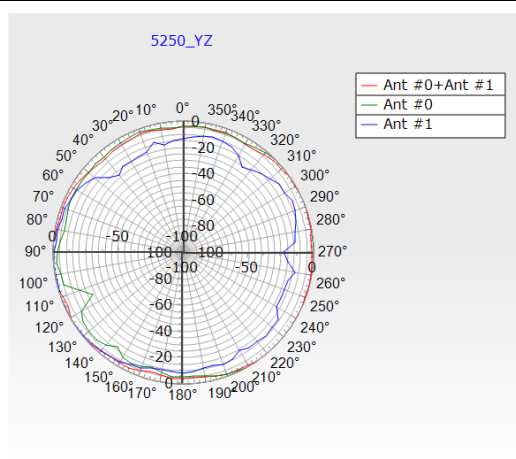
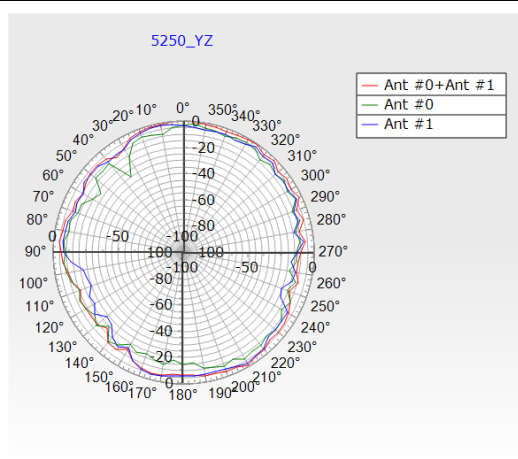
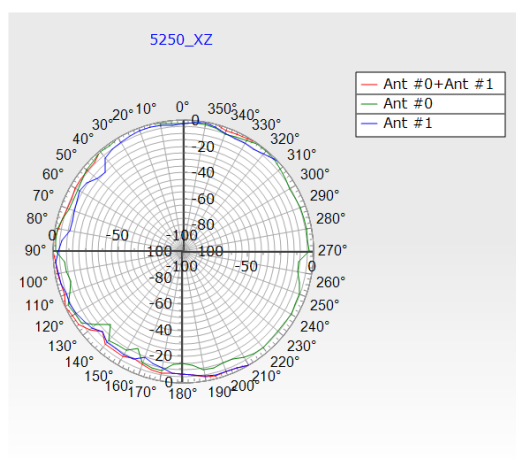
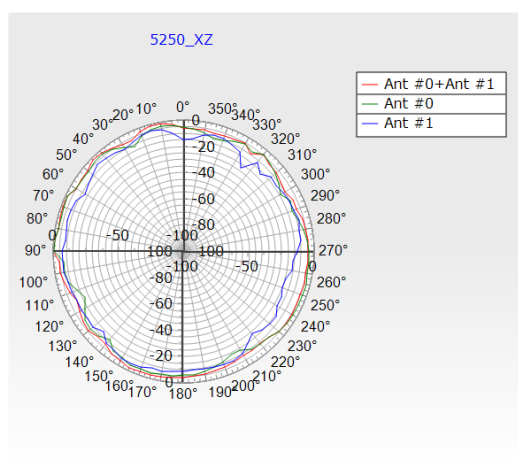
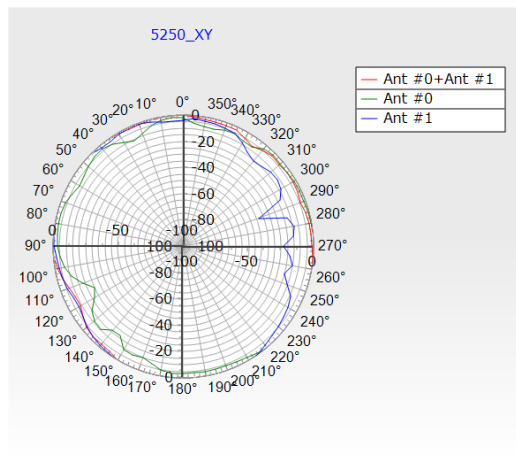
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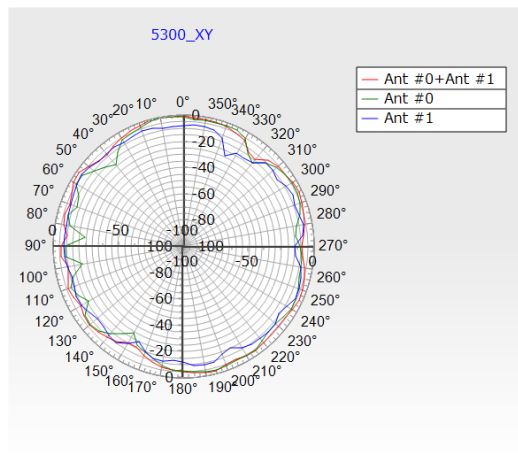
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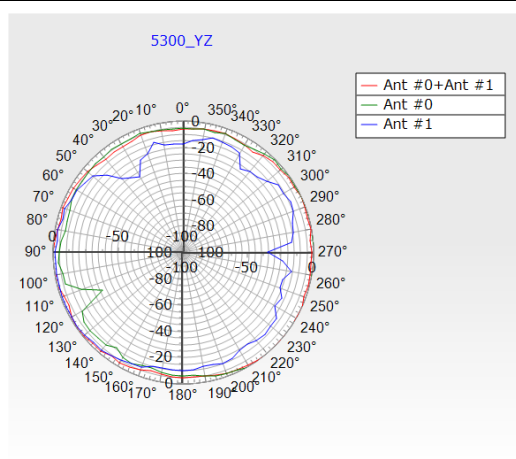
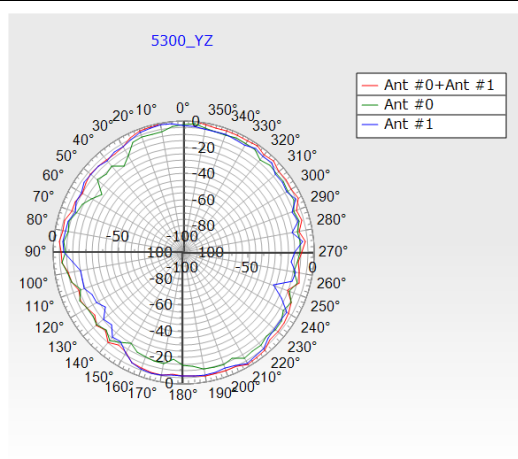
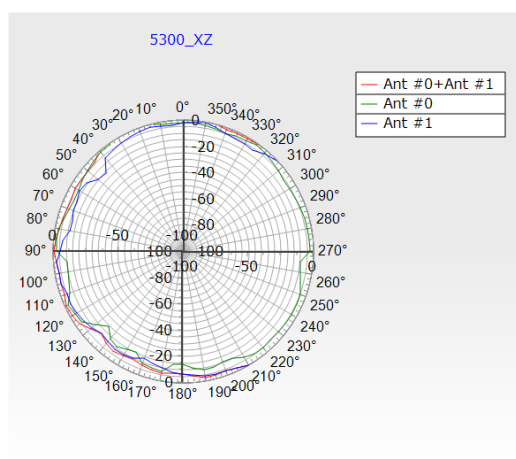
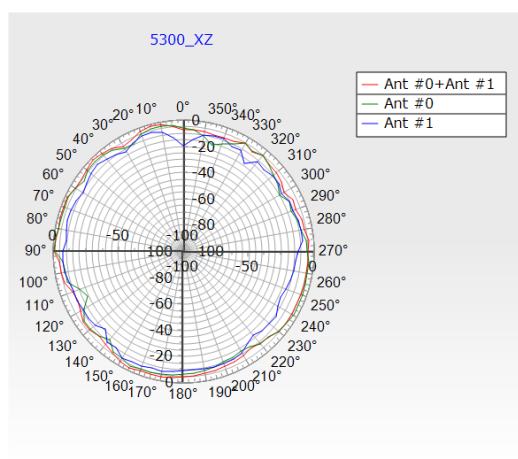
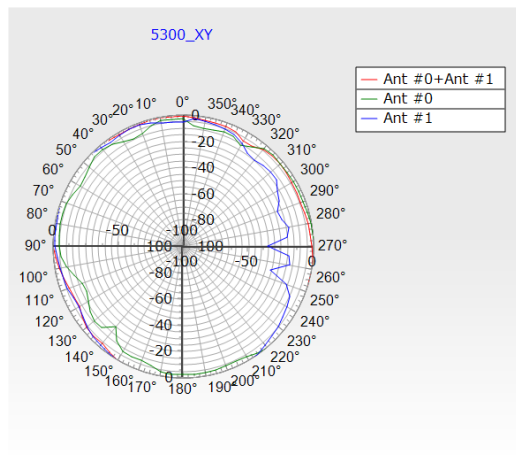
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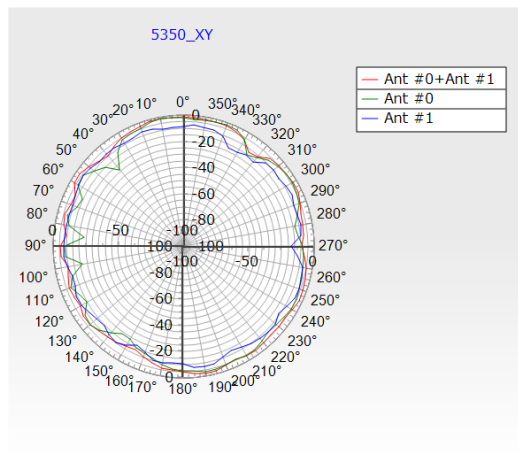
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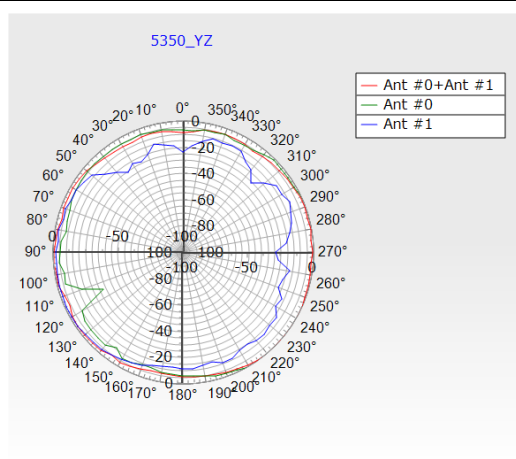
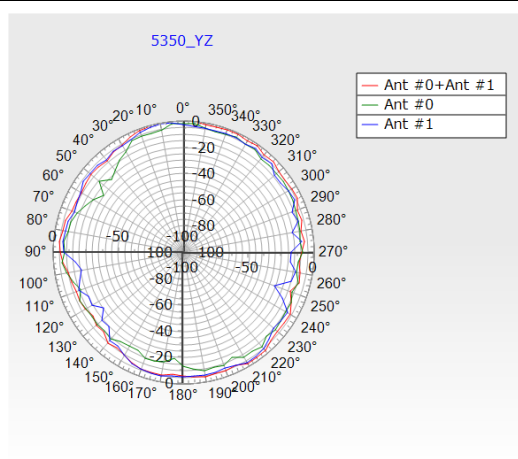
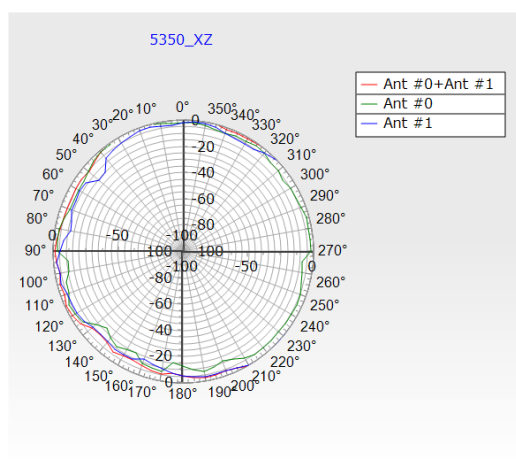
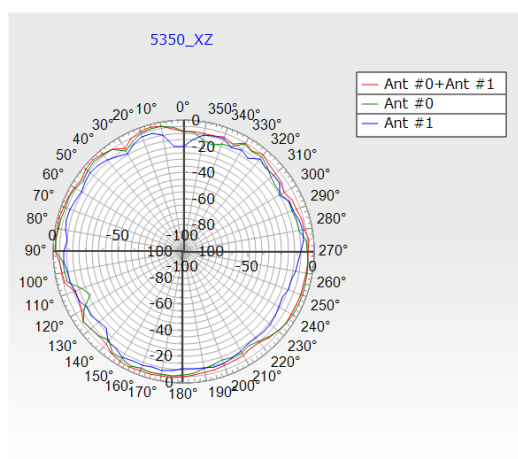
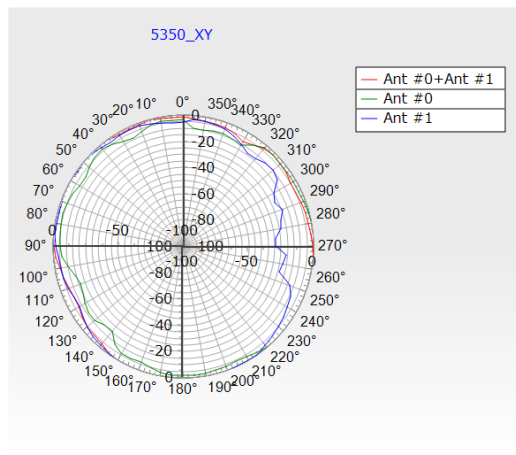
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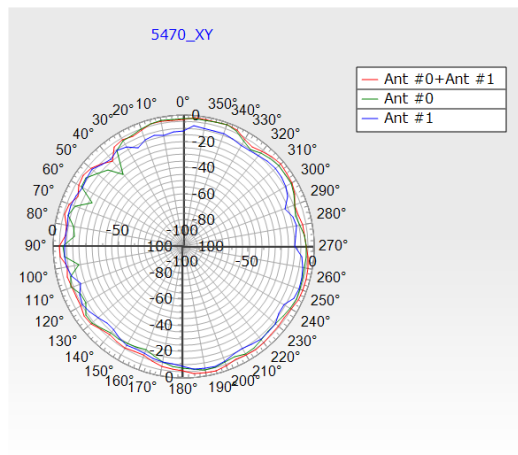
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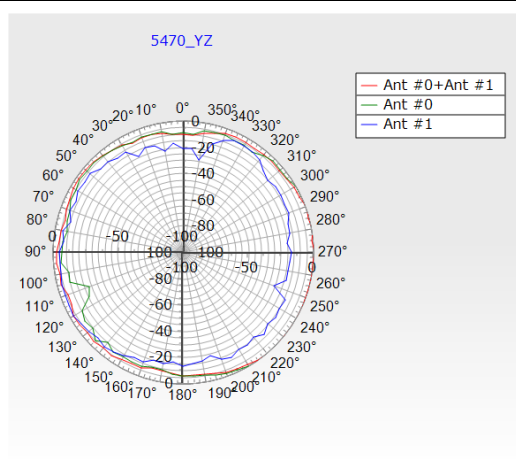
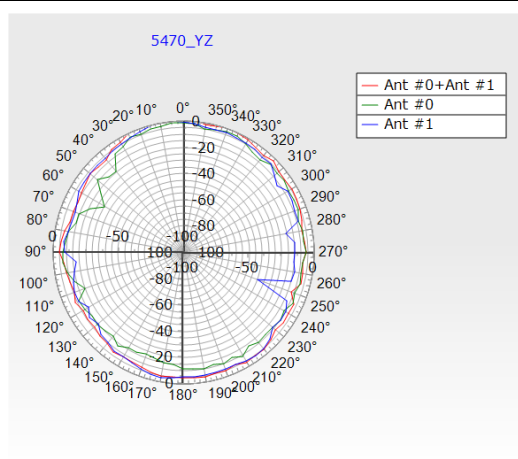
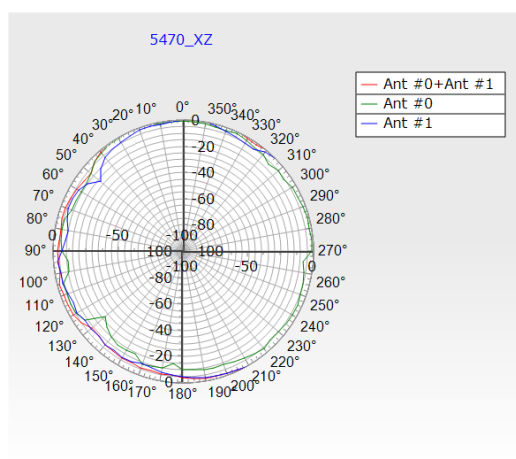
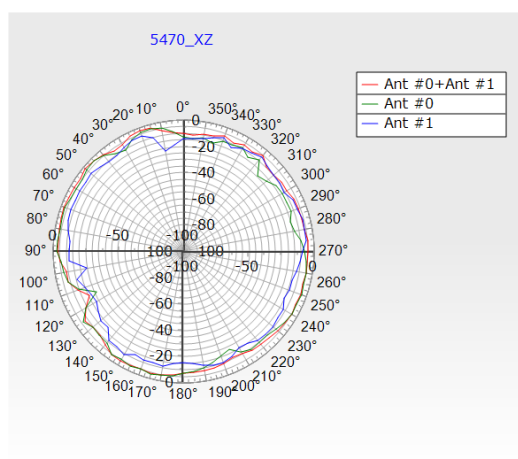
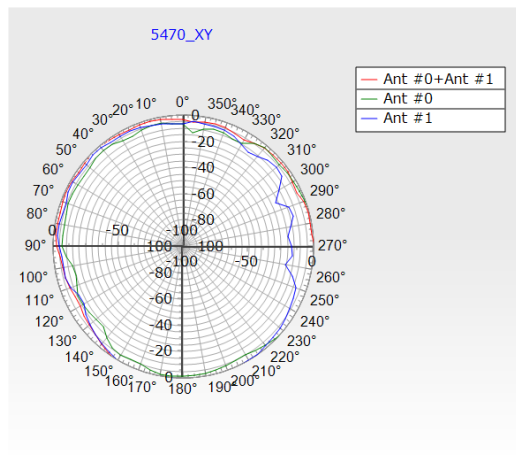
Theta_5350MHz



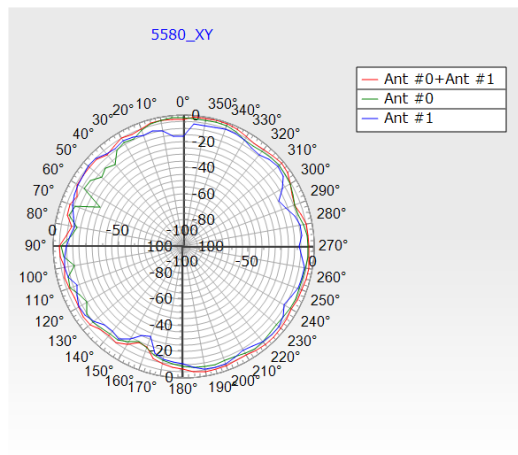
Phi_5470MHz



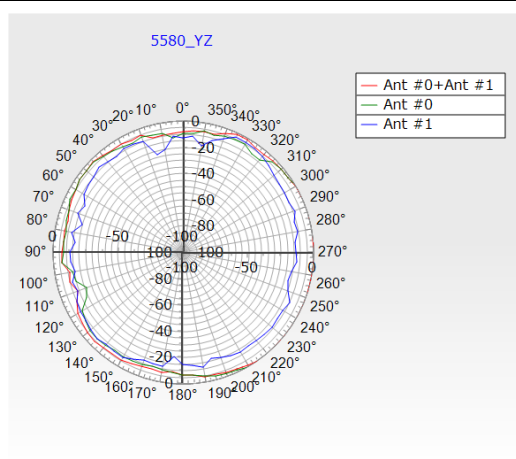
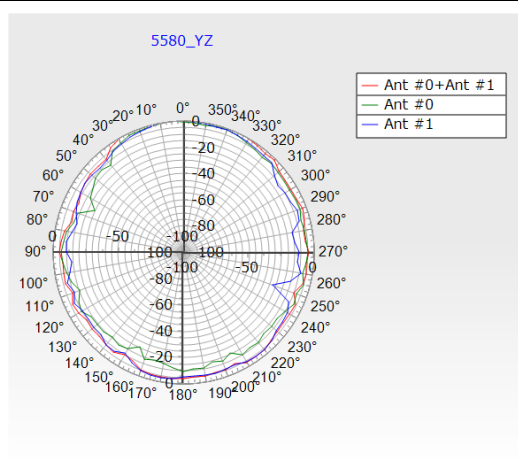
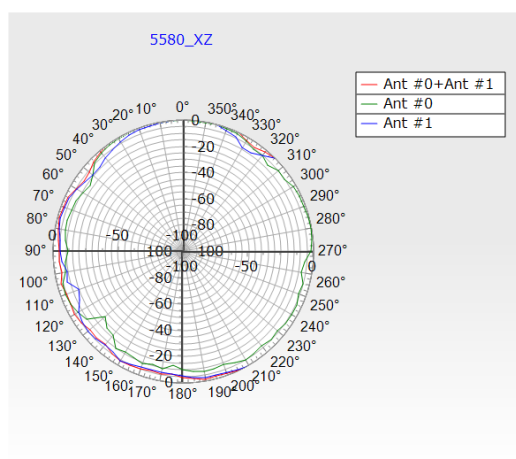
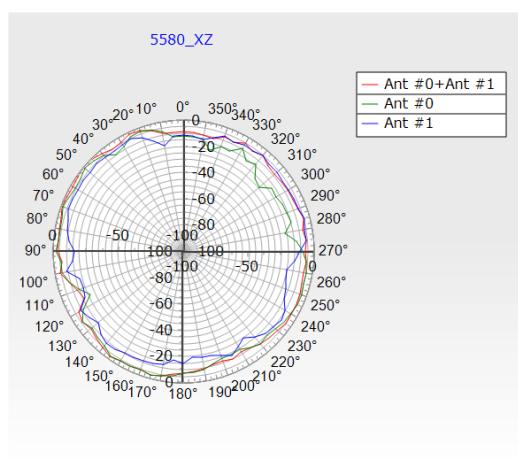
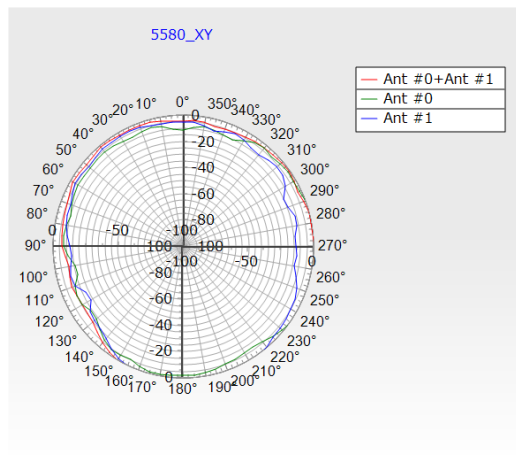
Theta_5470MHz



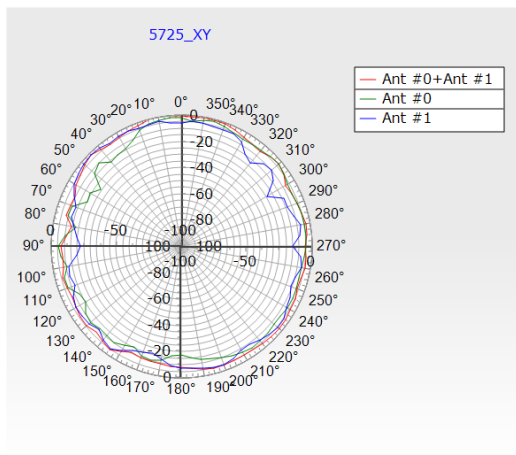
Phi_5580MHz



Theta_5580MHz



Phi_5725MHz



Theta_5725MHz

