Project Name:Teton
Antenna Test Report

May 20, 2025
Prepared by: AK

Introduction

- This report presents the passive antenna performance for Teton
- Sercomm integrated 19 antennas into the tooling housing

  8 LTE/5G NR antennas (Low Band、Middle Band、High Band、Ultra High Band)

  4 WiFi DB antennas (2.4-2.5GHz and 5.15-5.85GHz band of operation)

  4 WiFi 6G antennas (5.925-7.125GHz Band of operation)

  1 IOT Antennas (Zigbee)

  1 BT antenna (2.4-2.5GHz band of operation)

  1 GNSS antenna (L1/L5)
- Cable losses are included in the measurement data
- Each antenna radiation pattern is fixed and cannot generate multiple beams

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Antenna Details_LTE/5G NR & GNSS

Item	Part number	Operating Band	Material	Type	Cable	Polarization	Connector	Ant No.
1	6172009XWA	617 ~ 894 MHz 1710 ~ 2200 MHz 2500 ~ 2700 MHz 3300 ~ 4200MHz	PCB+Metal	PIFA	229mm BK	Linear	U.FL	Ant2
2	6172009ZWA		PCB+Metal	PIFA	105.5mm RD	Linear	U.FL	Ant3
3	617200A0WA		PCB+Metal	PIFA	134mm GN	Linear	U.FL	Ant6
4	617200A1WA		PCB+Metal	PIFA	245mm BN	Linear	U.FL	Ant8
5	617200A2WA	1710 ~ 2200 MHz 2500 ~ 2700 MHz 3300 ~ 4200MHz	PCB	Dipole	48mm WH	Linear	U.FL	Ant1
6	617200A3WA		PCB	Dipole	117mm OG	Linear	U.FL	Ant4
7	617200A4WA		PCB	Dipole	127mm YE	Linear	U.FL	Ant5
8	617200A5WA		PCB	Dipole	109mm BU	Linear	U.FL	Ant7
9	617200APWA	L1 / L5	PCB	Dipole	32mm GY	Linear	U.FL	GNSS

Antenna Details_LTE/5G NR & GNSS

Item	Part number	Operating Band	Material	Type	Cable	Polarization	Connector	Ant No.
10	6172009NWA	2400 ~ 2500 MHz 5150 ~ 5850 MHz	PCB	Dipole	70mm WH	Linear	U.FL	DB0
11	6172009PWA		PCB	Dipole	96mm RD	Linear	U.FL	DB2
12	6172009QWA		PCB	Dipole	48mm BK	Linear	U.FL	DB1
13	6172009RWA		PCB	Dipole	80mm OG	Linear	U.FL	DB3
14	6172009TWA	5925 ~ 7125 MHz	PCB	Dipole	36mm WH	Linear	U.FL	6G0
15	6172009UWA		PCB	Dipole	181mm BK	Linear	U.FL	6G2
16	6172009VWA		PCB	Dipole	210mm RD	Linear	U.FL	6G1
17	6172009WWA		PCB	Dipole	60mm OG	Linear	U.FL	6G3
18	6172009SWA	2400 ~ 2500 MHz	PCB	Dipole	50mm BU	Linear	U.FL	BT
19	617200A6WA	2400 ~ 2500 MHz	PCB	Dipole	110mm GY	Linear	U.FL	ZigBee

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Test Infomation

Item	Description
Brand Name	T-Mobile
Equipment	Teton (need to confirm)
Test Location	8F, No. 3-1, YuanQu St. Taipei, Taiwan 115 R.O.C.
Test Condition	Radiation
Test Engineer	AK Chen, Sercomm
Test Environment	ETS-Lindgren AMS-8500 Antenna Measurement Chamber
Test Date	Mar. 27, 2025
Measurement control	EMQuest V1.09

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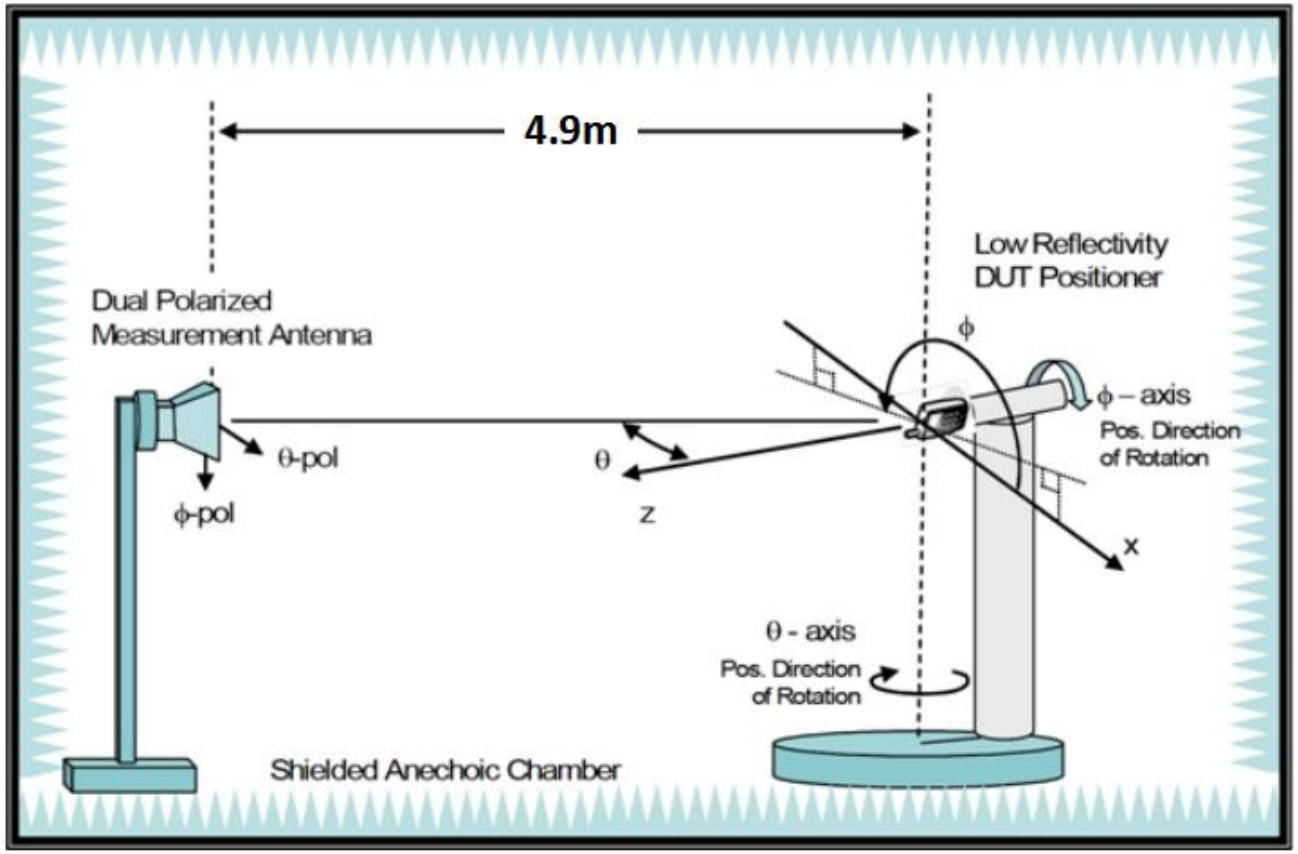
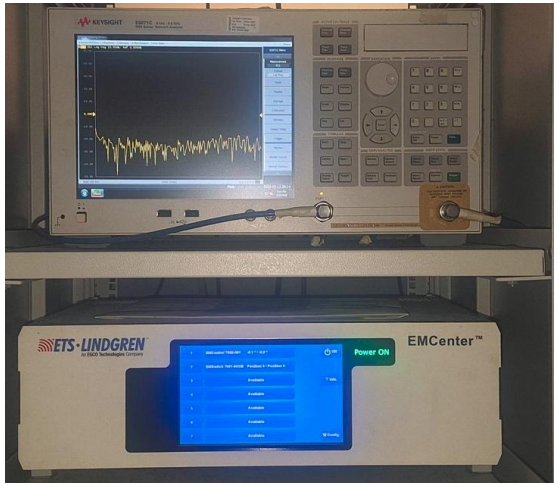
Test Configuration

ETS-Lindgren AMS-8500 antenna measurement system with a size of 7.32(L) × 3.66(W) × 3.66(H) m^3 is used for antenna performance test, which is based on the great-circle test method defined by CTIA. The multi-axis positioning system (MAPS) rotates the DUT around two orthogonal axes for full spherical coverage.





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Test Setup & Procedure

1. Fix the DUT on the dielectric support structure and connect the feeding cable to the antenna used for test
2. Set measurement parameters such as frequency range and sampling angle
3. Perform test and then get far-field data (radiation pattern, gain, efficiency)
4. Repeat test procedure for other antennas

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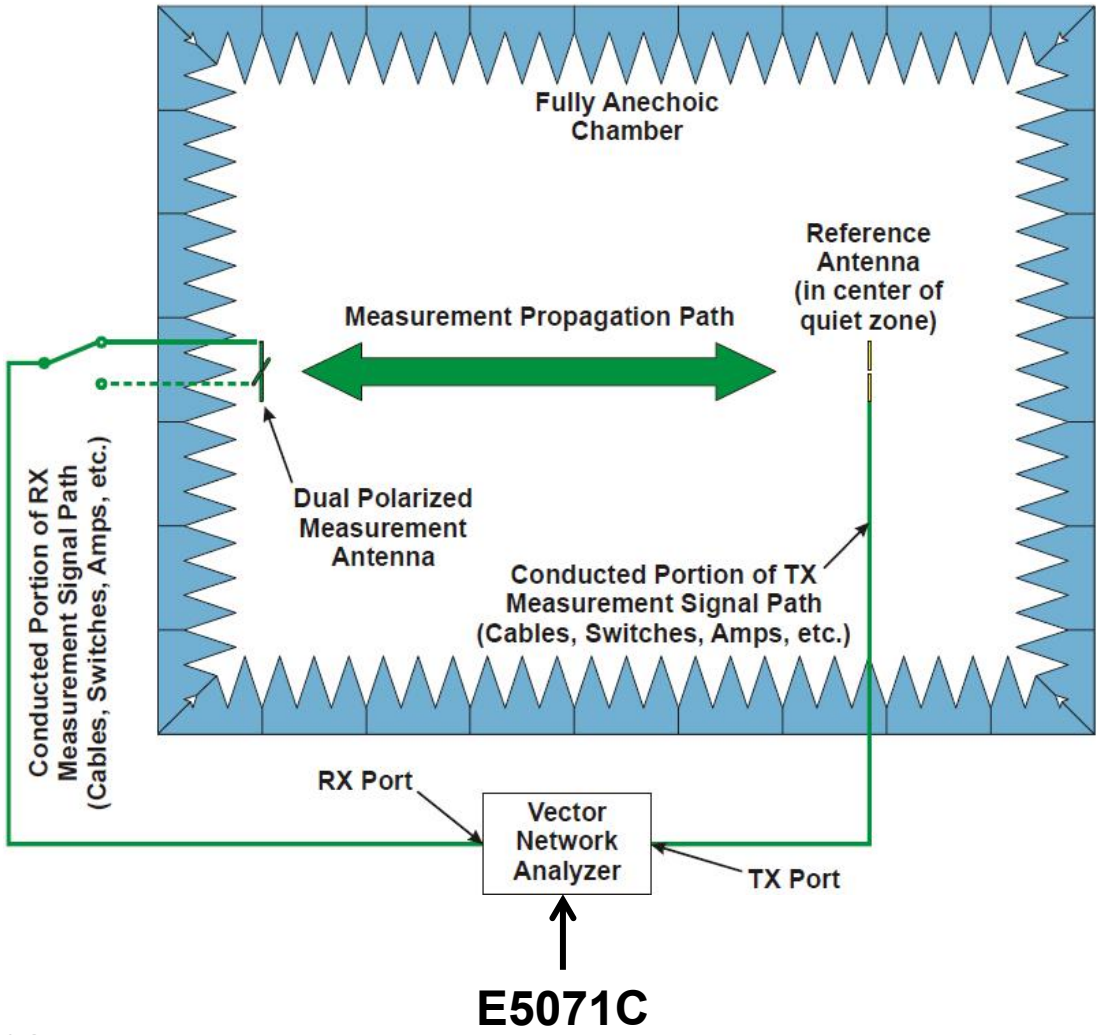
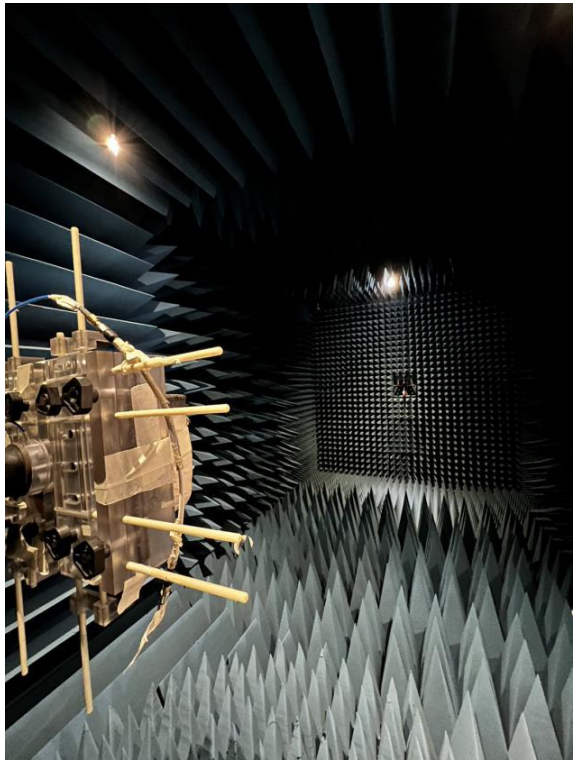
Test Equipment & Calibration

Network analyzer and reference antennas are used for calibration. Path loss and cable loss for different frequency bands can be checked and calculated.





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Test Equipment & Calibration

Instrument	Brand	Characteristics	Model No.	Serial No.	Calibration Date	Calibration Due Date
Precision Sleeve Dipole	ETS-Lindgren	700 MHz ~ 900 MHz	3126-700	00169715	Nov 21, 2024	Nov 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	900 MHz ~ 1000 MHz	3126-900	00169592	Nov 21, 2024	Nov 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	1400 MHz ~ 1700 MHz	3126-1550	00164599	Nov 21, 2024	Nov 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	1700 MHz ~ 2000 MHz	3126-1850	00169588	Nov 21, 2024	Nov 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	2000 MHz ~ 2300 MHz	3126-2150	00169593	Nov 21, 2024	Nov 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	2300 MHz ~ 2700 MHz	3126-2500	00169597	Nov 21, 2024	Nov 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	5000 MHz ~ 6000 MHz	3126-5500	00169728	Nov 21, 2024	Nov 21, 2025
Horn Antenna	SCHWARZBECK	1 GHz ~ 18 GHz	BBHA 9120D	BBHA 9120D-1294	Sep. 07, 2024	Sep. 07, 2025
EMQuest Antenna Measurement Software	ETS-Lindgren	Control chamber system	EMQ-100	1437	Non-Calibration Required	Non-Calibration Required
VNA	Keysight	9 KHz ~ 8.5 GHz	E5071C	MY46316900	July 15, 2024	July 15, 2025

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Result Summary - Gain & Efficiency Table_LTE/5GNR

Efficiency & Gain																
Frequency (MHz)	Ant1		Ant2		Ant3		Ant4		Ant5		Ant6		Ant7		Ant8	
	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)
663			35	-1.02	37	-2.23					42	-0.73			40	-0.55
680			41	-0.95	40	-0.97					41	-0.49			50	-0.15
707			49	-0.42	39	-0.46					46	0.4			60	0.51
737			45	1.13	39	-1.22					44	-1.77			62	1.19
836			43	-0.39	37	-2.32					35	-2.05			40	-1.24
881			36	-1.5	38	-3.1					34	-1.55			35	-1.54
1745	65	1.47	60	1.29	66	2.14	48	1.42	50	1.67	60	2.2	50	1.49	64	2.11
1880	61	2	62	1.37	61	2.64	54	3.18	51	1.59	63	3.43	58	1.58	65	3.05
1960	57	2.16	61	1.82	60	2.36	47	2.31	49	1.65	59	2.15	55	0.55	62	1.64
2155	64	3.59	61	1.89	60	3.11	56	3.03	55	3.09	58	3.45	64	2	62	2.48
2500	65	2.07	65	2.43	71	2.76	62	3.66	56	2.37	64	2.16	52	2.22	57	2.53
2600	68	2.48	65	2.64	69	2.2	62	3.5	63	2.68	65	2.23	52	2.21	51	1.96
2700	60	2.46	66	2.53	65	2.35	61	3.03	66	2.87	64	2.03	53	2.48	57	2.6
3300	65	1.5	64	2.25	58	2.49	67	2.33	59	2.21	64	2.14	53	1.24	68	1.75
3750	60	1.96	63	1.97	64	1.91	69	3.57	68	2.81	65	2.37	61	1.73	61	1.7
4200	60	1.99	60	2.89	71	2.85	61	3.07	68	2.88	68	2.21	65	1.71	62	2.19

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Result Summary - Gain Table Detail_LTE/5GNR

Frequency (MHz)	Ant1	Ant2	Ant3	Ant4	Ant5	Ant6	Ant7	Ant8
617		-1.24	-2.79			-1.09		-0.84
635		-1.04	-2.37			-0.46		-0.22
652		-0.65	-3.21			-0.91		0.05
663		-1.02	-2.23			-0.73		-0.55
680		-0.95	-0.97			-0.49		-0.15
698		-0.09	0.44			-0.33		0
707		-0.42	-0.46			0.4		0.51
716		0.12	-0.82			0.28		0.53
729		0.65	-1.17			-0.19		0.66
737		1.13	-1.22			-1.77		1.19
746		1.02	-1.82			-1.72		0.78
824		-0.13	-2.19			-2.57		-0.94
836		-0.39	-2.32			-2.05		-1.24
849		-0.41	-2.69			-1.44		-1.86
869		-0.66	-2.61			-1.81		-1.6
881		-1.5	-3.1			-1.55		-1.54
894		-1.71	-3.04			-2.66		-1.91
1710	1.48	0.79	1.64	1.67	1.76	2.2	1.36	1.9
1745	1.47	1.29	2.14	1.42	1.67	2.2	1.49	2.11
1780	1.46	1.88	1.66	1.49	1.98	1.93	1.42	1.87
1850	3.12	1.9	1.99	3.11	1.17	3.13	0.96	2.48
1880	2	1.37	2.64	3.18	1.59	3.43	1.58	3.05
1915	1.38	1.52	2.88	2.89	1.96	2.89	1.09	1.71
1930	1.72	1.53	2.74	2.7	1.99	2.52	0.64	1.52
1960	2.16	1.82	2.36	2.31	1.65	2.15	0.55	1.64
1995	2.9	1.82	2.37	2.63	1.47	2.03	1.5	1.84
2110	3.32	2.4	2.64	3.13	3.28	3.06	3.46	2.52
2155	3.59	1.89	3.11	3.03	3.09	3.45	2	2.48
2200	3.5	1.51	3.45	2.93	2.64	3.34	1.74	2.65
2500	2.07	2.43	2.76	3.66	2.37	2.16	2.22	2.53
2600	2.48	2.64	2.2	3.5	2.68	2.23	2.21	1.96
2700	2.46	2.53	2.35	3.03	2.87	2.03	2.48	2.6
3300	1.5	2.25	2.49	2.33	2.21	2.14	1.24	1.75
3750	1.96	1.97	1.91	3.57	2.81	2.37	1.73	1.7
4200	1.99	2.89	2.85	3.07	2.88	2.21	1.71	2.19

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Result Summary - Gain & Efficiency Table_WiFi DB

Efficiency & Gain								
Frequency (MHz)	DB0		DB1		DB2		DB3	
	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)
2400	64	2.46	63	2.53	60	3.09	60	2.01
2450	64	2.83	62	2.33	63	3.47	61	1.70
2500	63	3.33	58	1.66	65	3.88	61	1.64
5150	70	2.85	64	3.50	68	3.36	62	3.55
5200	69	2.85	63	3.53	68	3.47	62	3.46
5250	69	2.85	62	3.79	68	3.47	63	3.48
5300	68	2.84	64	3.54	70	3.39	66	3.47
5350	70	3.15	64	3.09	71	3	66	3.30
5400	72	3.31	62	2.70	71	3.19	65	3.19
5450	73	3.17	60	2.67	70	3.68	64	3.19
5500	74	3.31	61	2.85	72	3.64	65	3.42
5550	74	3.24	61	2.80	71	3.3	65	3.31
5600	74	3.32	60	3.25	69	3.3	64	2.91
5650	75	3.36	61	3.94	70	3.13	64	3.02
5700	76	3.32	62	4.11	71	3.19	65	3.17
5750	76	3.78	62	4.09	71	3.37	65	3.13
5800	75	4.48	61	3.73	71	3.45	64	3.53
5850	75	4.59	60	3.18	72	3.95	64	3.10

Result Summary - Gain & Efficiency Table_WiFi 6G

Efficiency & Gain								
Frequency (MHz)	6G0		6G1		6G2		6G3	
	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)
5925	66	4.49	60	3.55	60	4.42	69	4.58
6000	62	4.15	58	2.98	61	4.51	65	4.15
6100	65	4.36	58	2.95	59	3.8	64	3.6
6200	62	4.28	60	2.47	57	3.21	62	3.59
6300	63	4.86	59	2.84	58	3.15	61	3.27
6400	64	4.92	58	2.67	57	2.77	65	3.78
6500	64	5	59	2.26	60	2.16	63	3.57
6600	62	4.55	60	2.59	57	2.08	63	3.26
6700	64	4.78	62	2.13	57	2.45	65	3.29
6800	62	4.56	62	2	60	3.05	63	3.46
6900	62	4.8	62	2.35	58	3.22	62	3.21
7000	62	4.56	61	2.94	57	2.76	62	3.18
7100	62	4.2	59	2.84	56	3.08	61	3.16
7125	61	4.09	58	2.89	55	2.97	61	3.18

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Result Summary - Gain & Efficiency Table_GNSS & ZigBee & BT

Efficiency & Gain						
Frequency (MHz)	GNSS		Zigbee/BT (MG21)		BT (BG21)	
	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)
1175	50	0.92				
1575	58	3.51				
2400			51	5.01	54	5.36
2450			53	4.71	55	5.11
2500			54	4.21	55	4.4

Result Summary - WiFi DB_Correlated Gain

Frequency (MHz)	Correlated Gain Phi (dBi)	Correlated Gain Theta (dBi)
2400	3.55	4.61
2450	3.05	5.18
2500	3.01	5.38
5150	5.82	3.83
5200	5.95	4.28
5250	5.97	4.52
5300	6.00	4.81
5350	5.84	4.84
5400	5.89	4.84
5450	5.91	4.98
5500	5.94	5.18
5550	5.91	5.09
5600	5.49	5.02
5650	5.57	5.05
5700	5.97	4.78
5750	5.92	4.77
5800	5.82	5.20
5850	5.70	5.92

Result Summary - WiFi 6G_Correlated Gain

Frequency (MHz)	Correlated Gain Phi (dBi)	Correlated Gain Theta (dBi)
5925	5.05	2.91
6000	4.32	2.62
6100	4.37	2.92
6200	4.75	2.47
6300	4.92	2.78
6400	4.74	3.12
6500	4.49	2.79
6600	4.61	3.28
6700	3.84	2.59
6800	3.94	2.36
6900	3.8	2.81
7000	3.98	3.26
7100	3.95	3.39
7125	3.7	3.32

Direction Gain Calculations

Because the antennas are fixed in location within the device the directional antenna gain for MIMO is calculated over a sphere using the raw spatial data taken at 5 degree steps of theta and phi for each antenna using the equations from KDB 662911 D01.

The correlated antenna gain was calculated using KDB 662911 D01, F(2)(d)(i)

The correlated gain was calculated for each point in the spatial data, and the highest value reported.

2.4GHz correlated calculation:
Maximum correlated gain: 5.38dBi
= 10*LOG(((10^(G0/20)+10^(G1/20)+10^(G2/20)+10^(G3/20))^2)/4)
= 10*LOG(((10^(0.20/20)+10^(-4.12/20)+10^(1.63/20)+10^(-1.27/20))^2)/4)

This occurs at: 2500MHz, phi 330/theta 80

5GHz correlated calculation:
Maximum correlated gain: 6 dBi
= 10*LOG(((10^(G0/20)+10^(G1/20)+10^(G2/20)+10^(G3/20))^2)/4)
= 10*LOG(((10^(0.79/20)+10^(0.35/20)+10^(0.71/20)+10^(-2.27/20))^2)/4)

This occurs at: 5300MHz, phi 355/theta 135

6GHz correlated calculation:
Maximum correlated gain: 5.05dBi
= 10*LOG(((10^(G0/20)+10^(G1/20)+10^(G2/20)+10^(G3/20))^2)/4)
= 10*LOG(((10^(-6.13/20)+10^(3.19/20)+10^(2.52/20)+10^(-10.39/20))^2)/4)

This occurs at: 5925MHz, phi 10/theta 60

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Appendix

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LTE/5G NR

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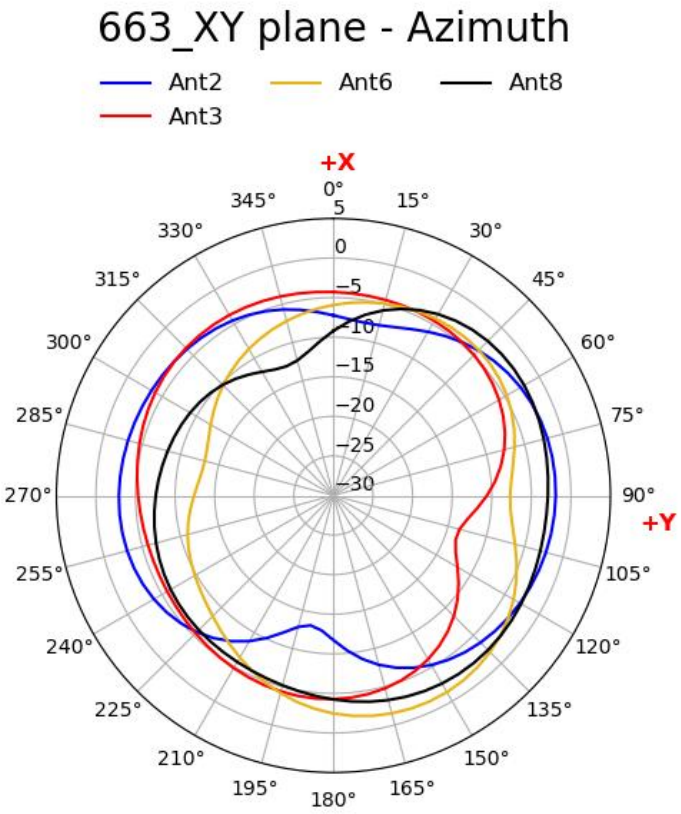
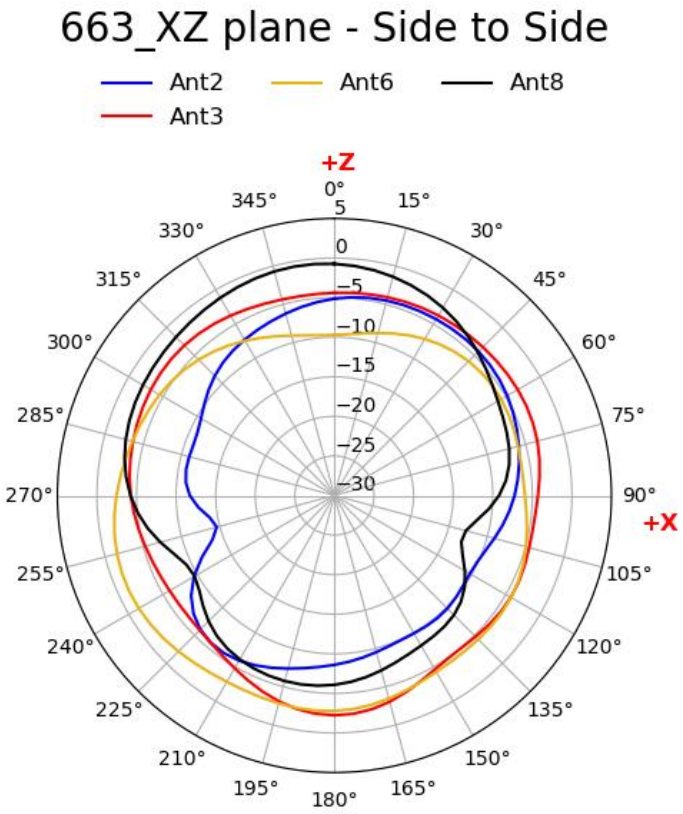
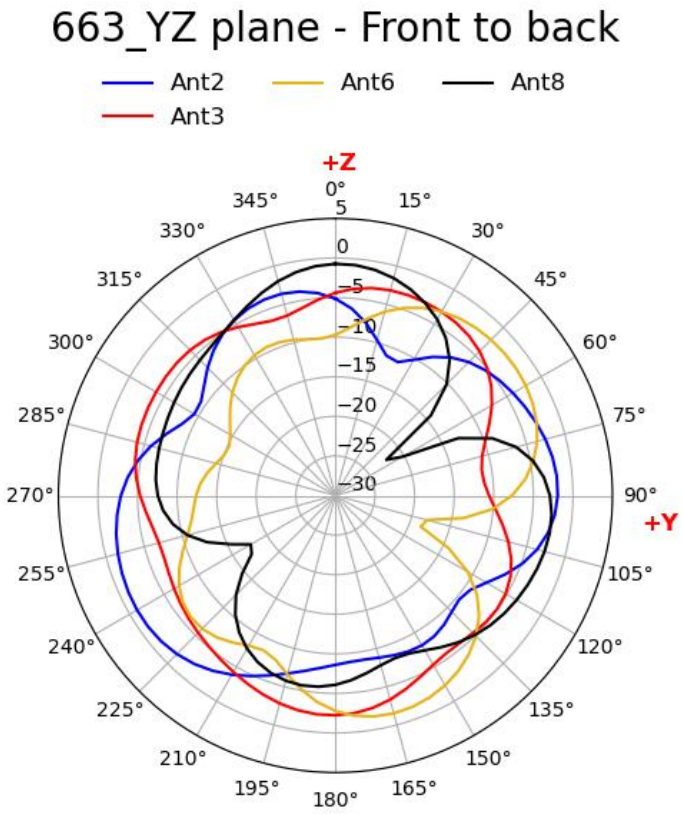
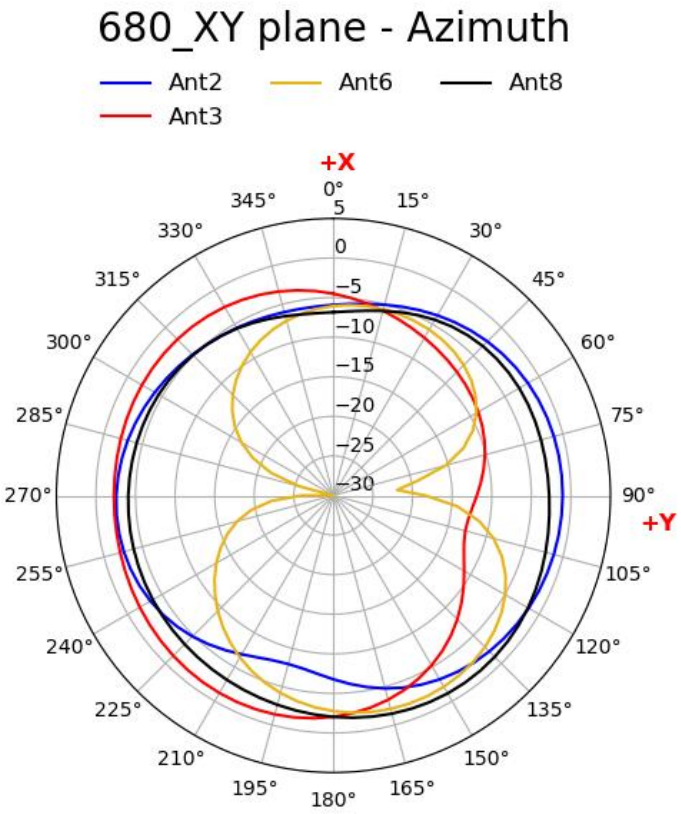
System Coverage - n71@663MHz

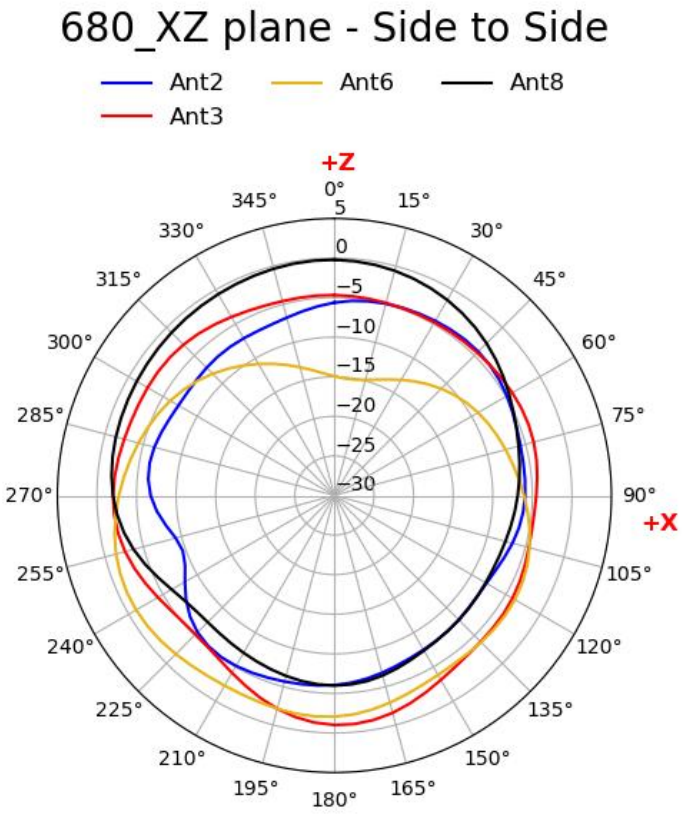


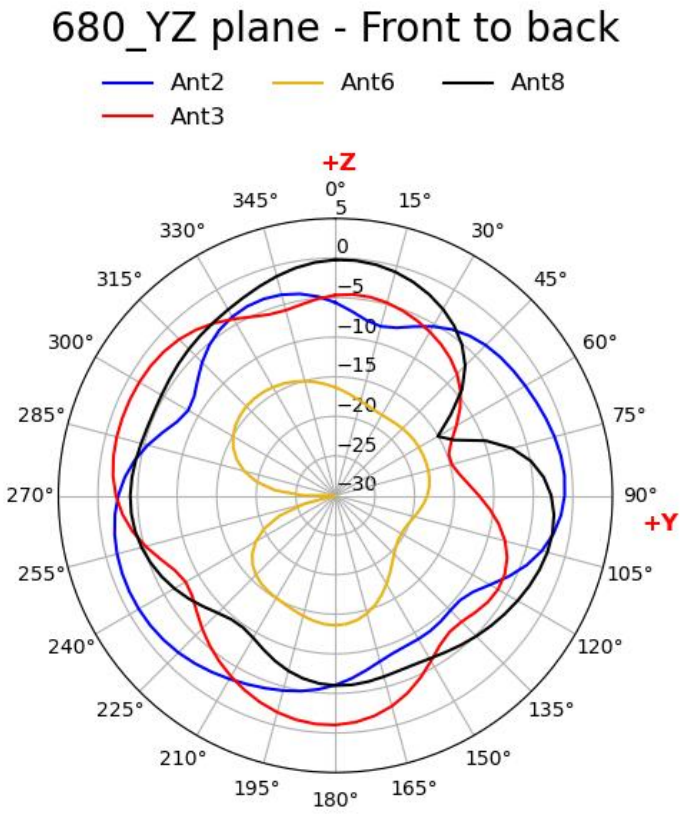




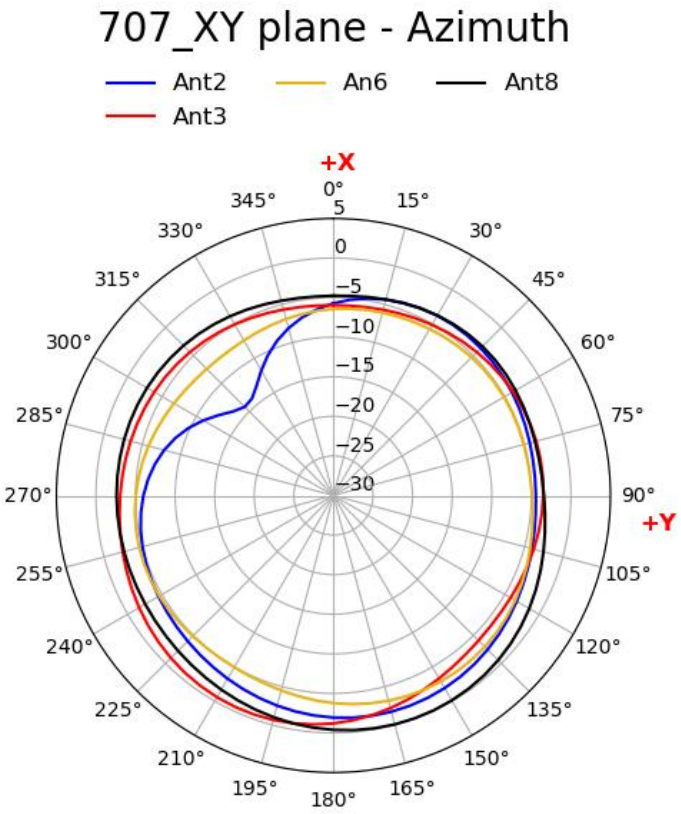
System Coverage - n71@680MHz

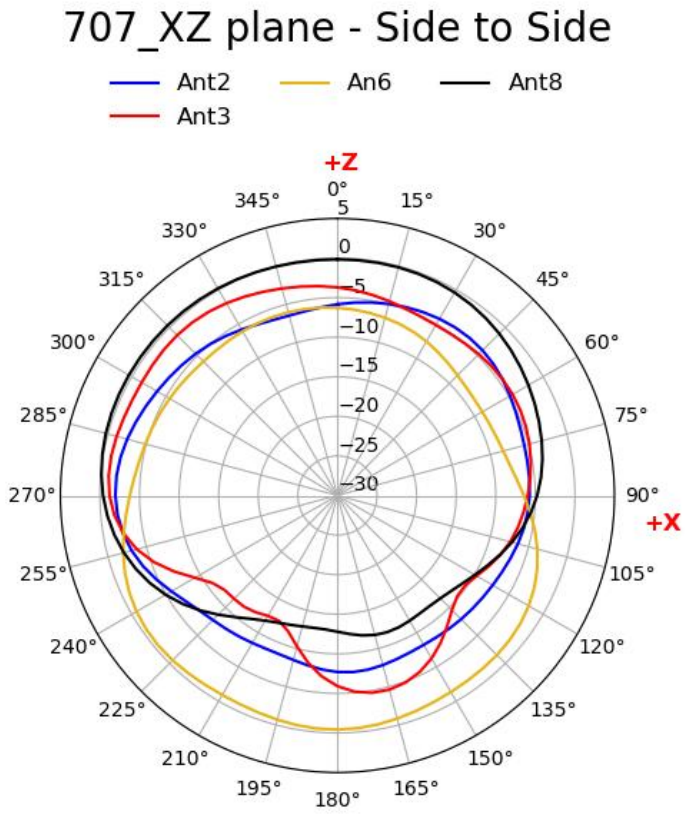


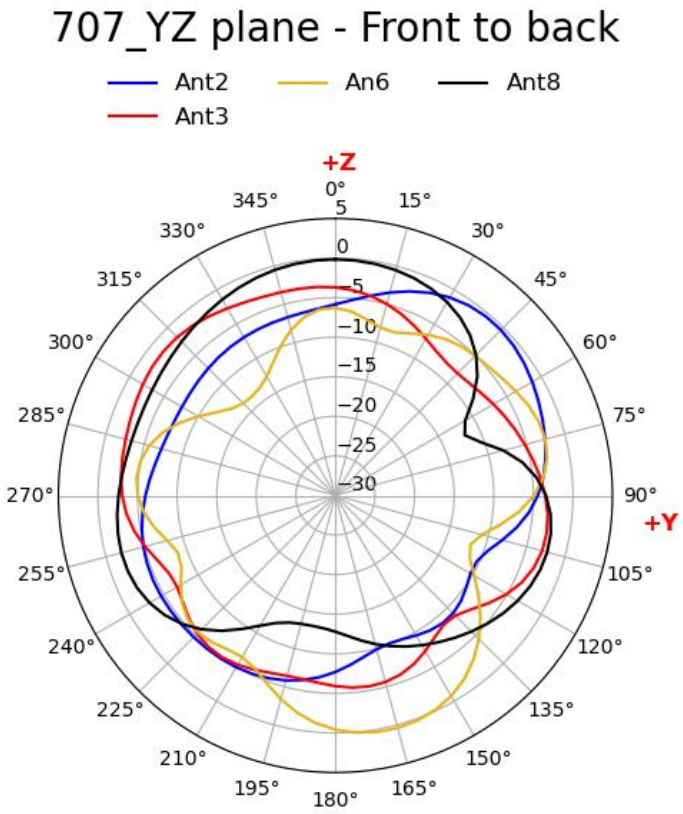




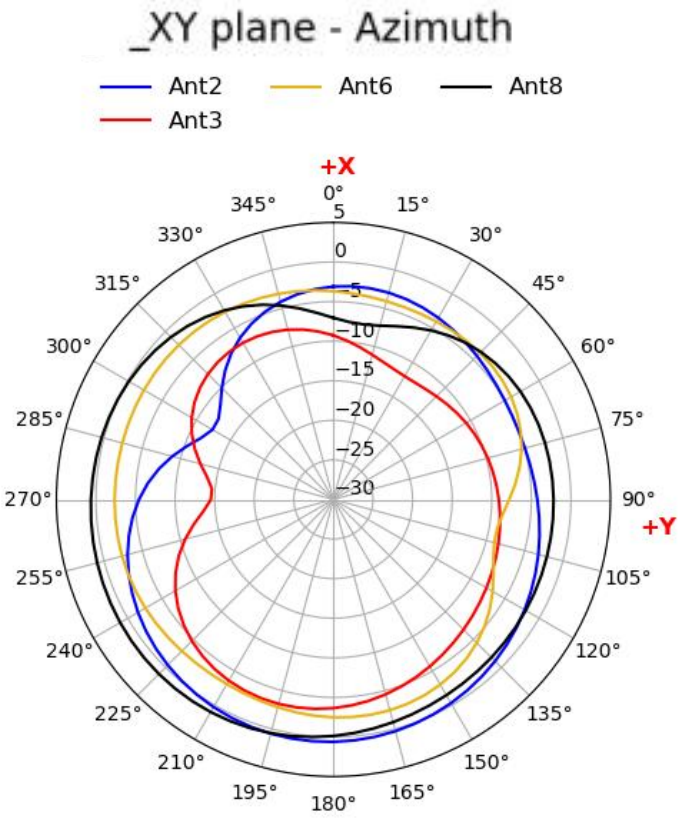
System Coverage - B12@707MHz

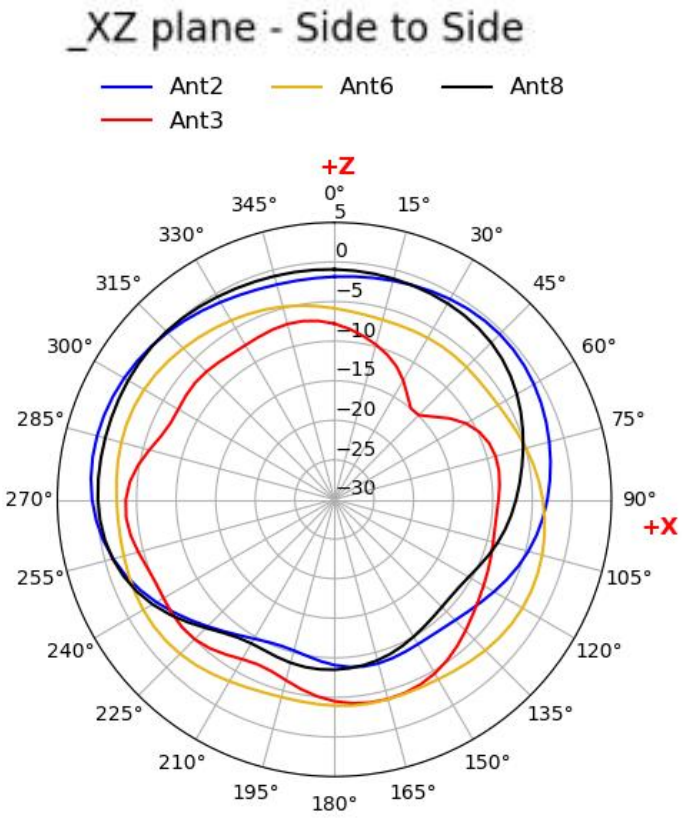


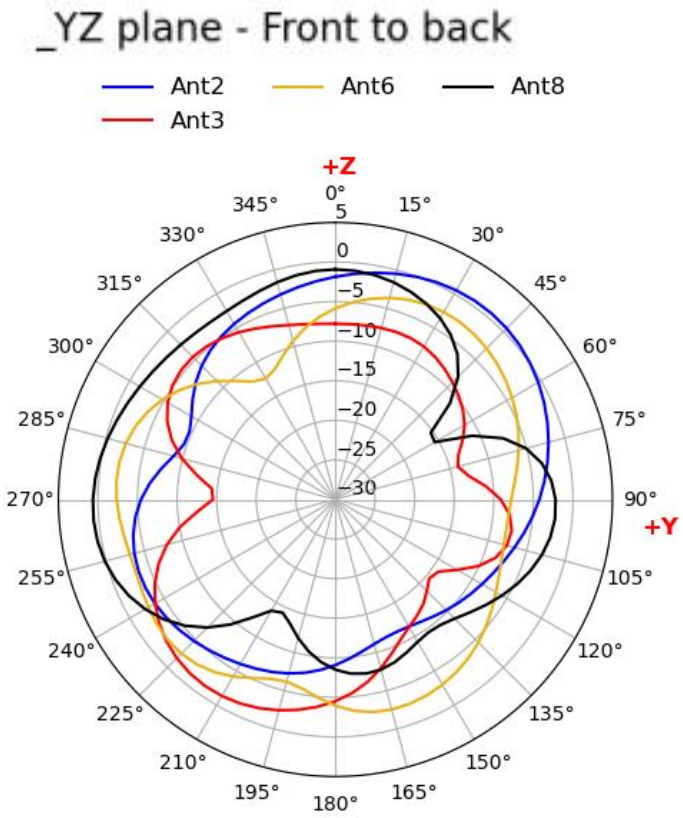




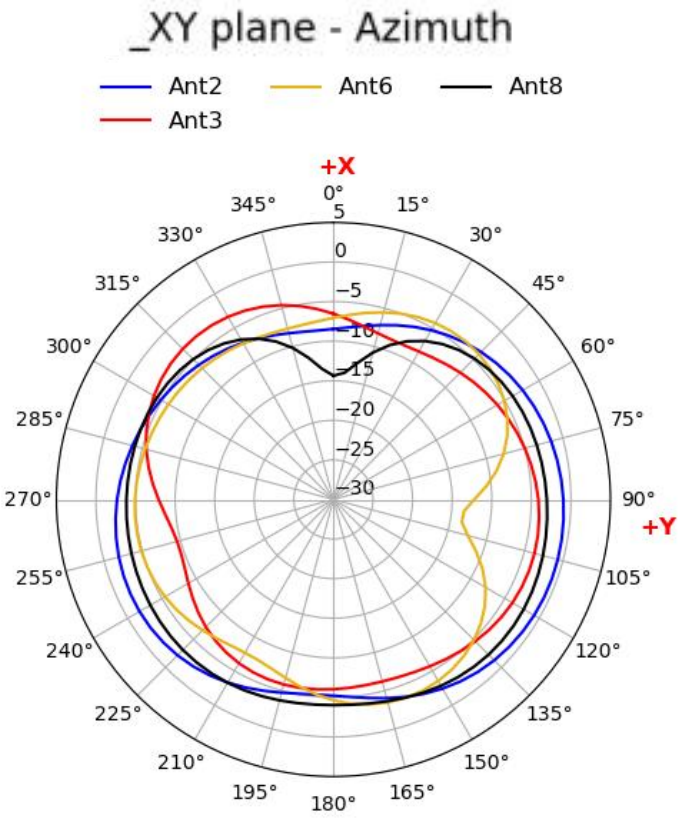
System Coverage - B12@737MHz

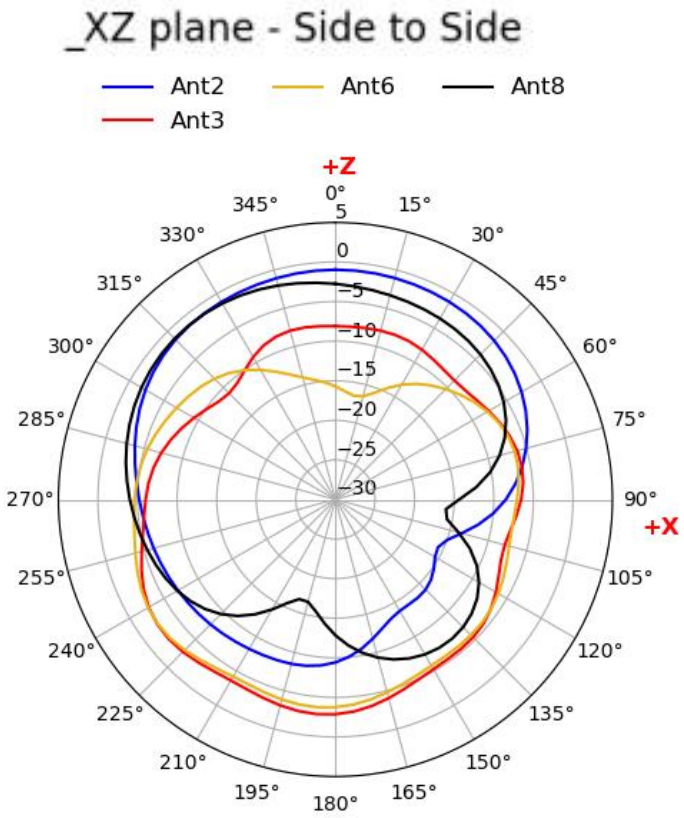


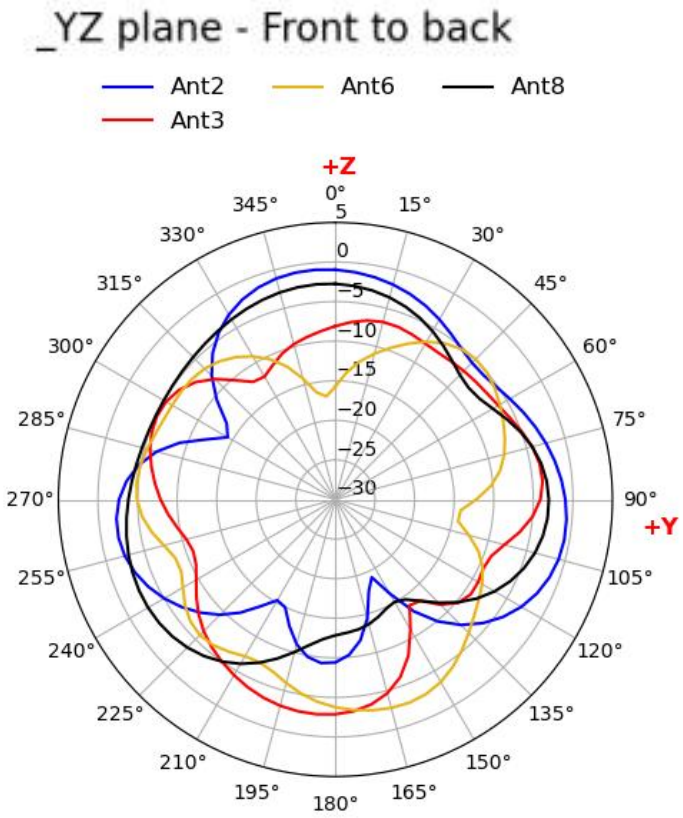




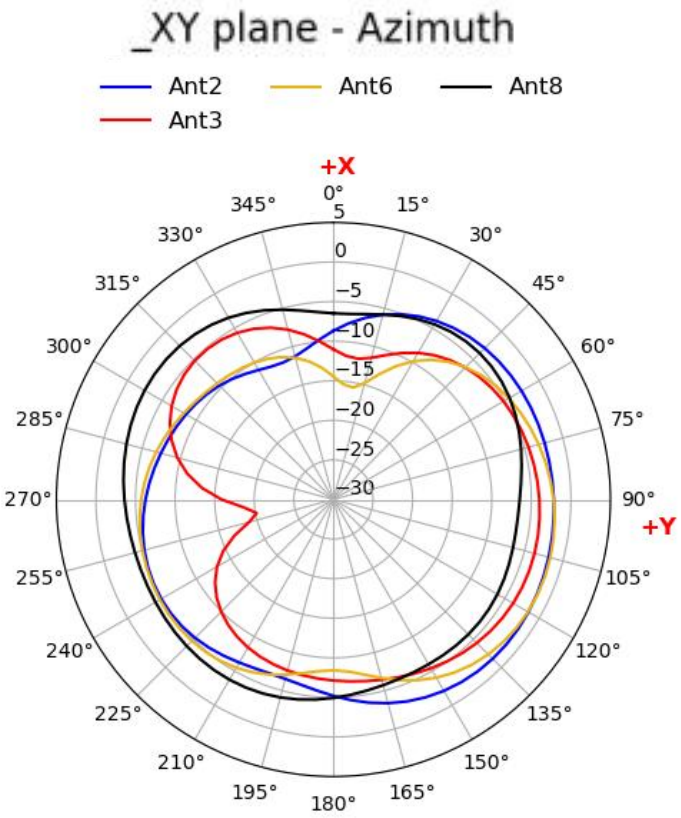
System Coverage - n5/B5@836MHz

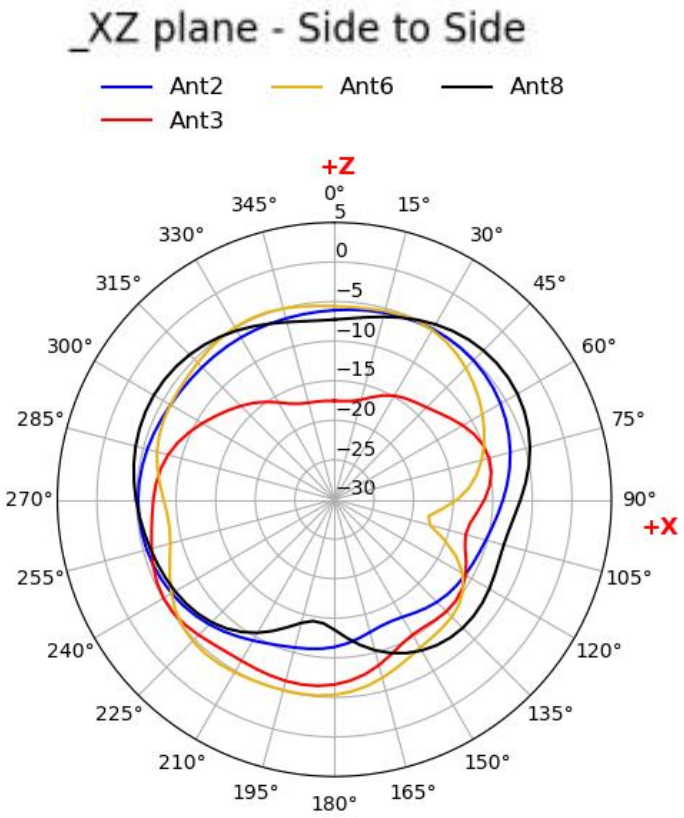


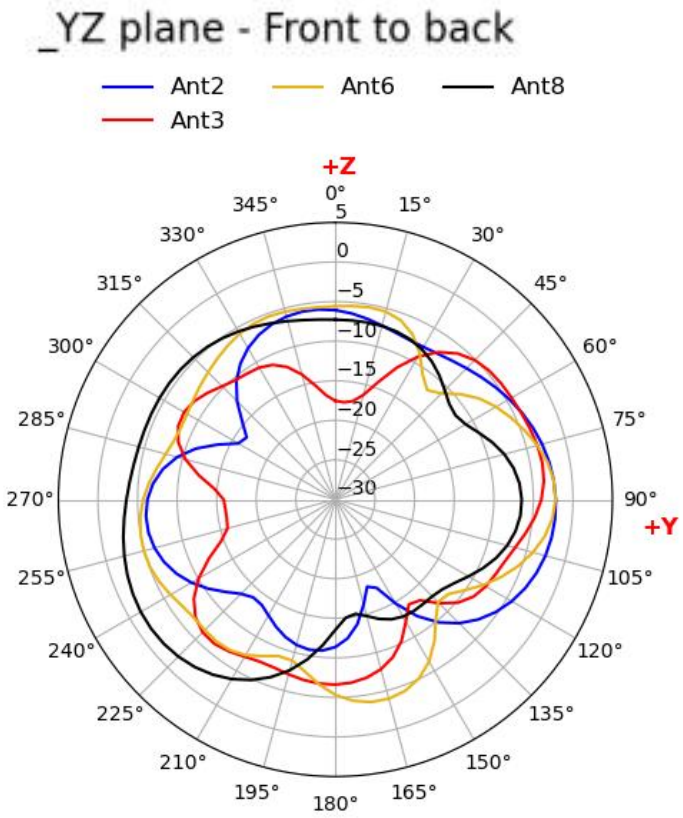




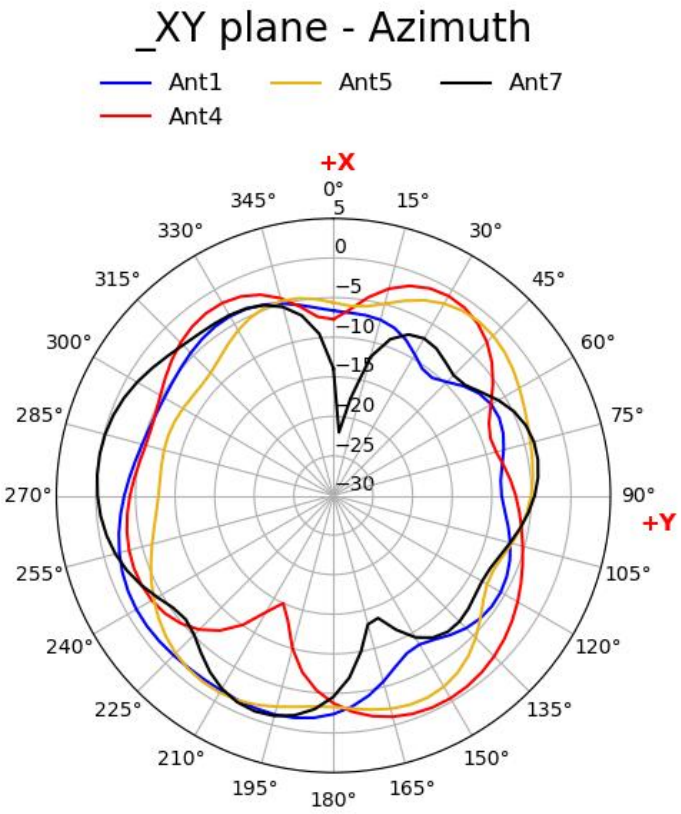
System Coverage - n5/B5@881MHz

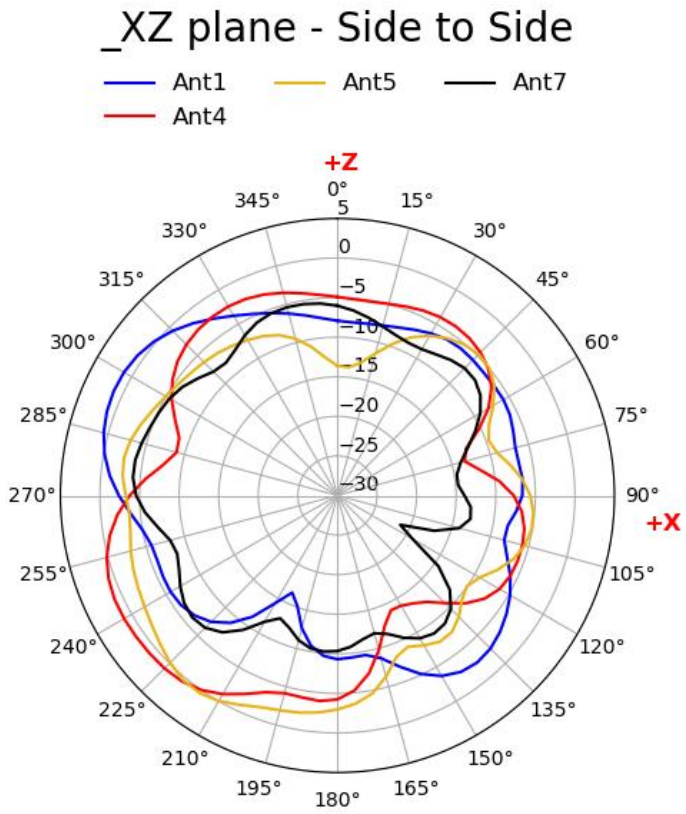


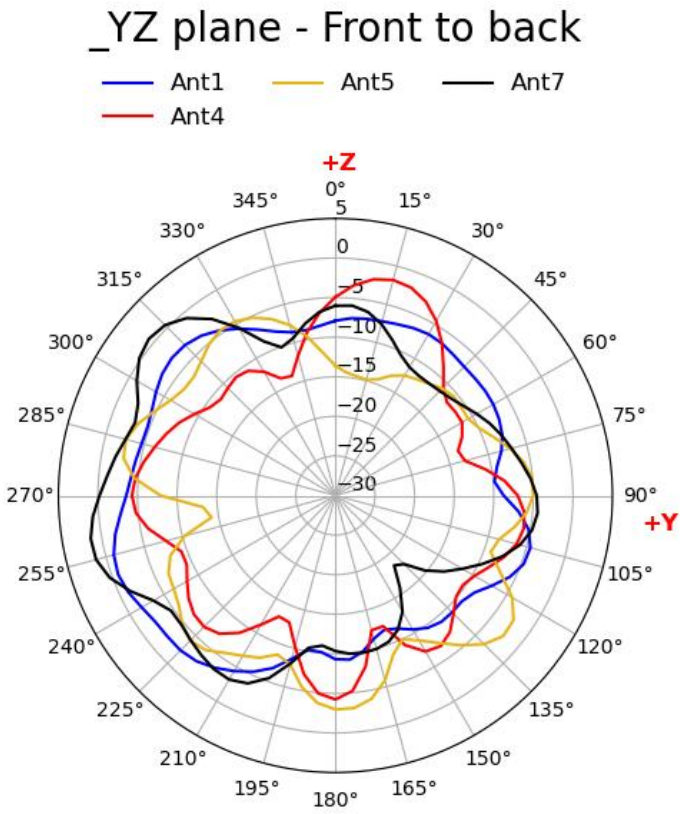




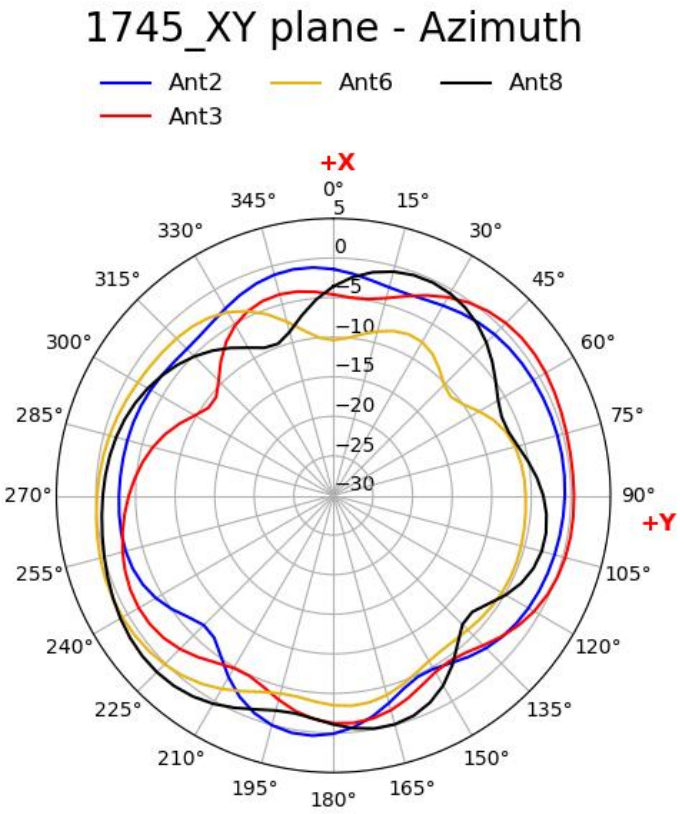
System Coverage - n66/B66/B4@1745MHz

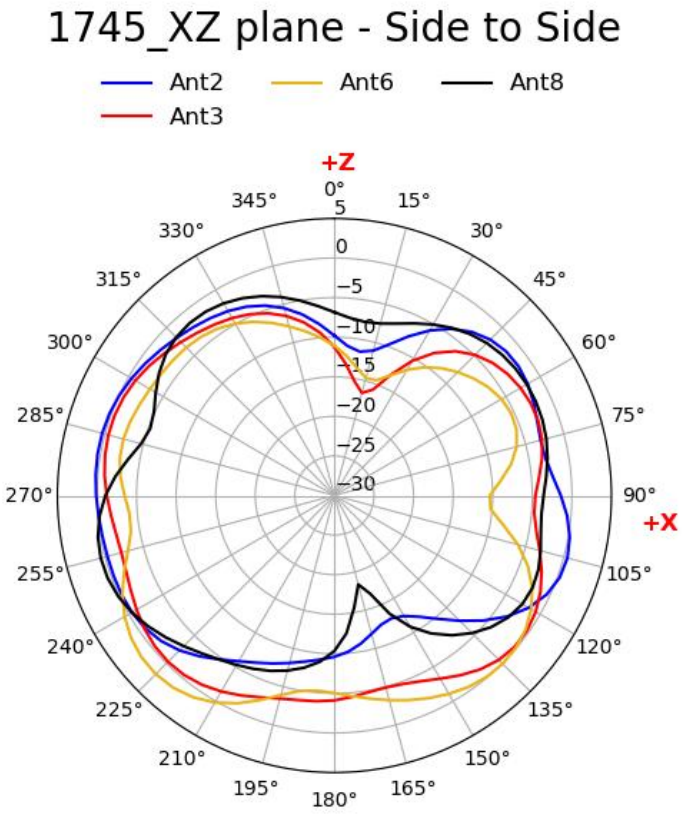


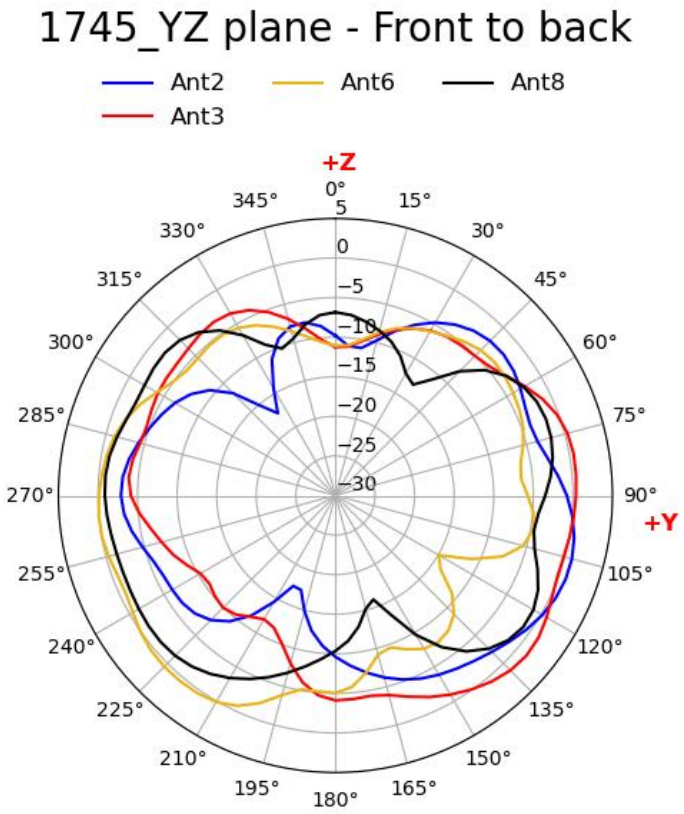




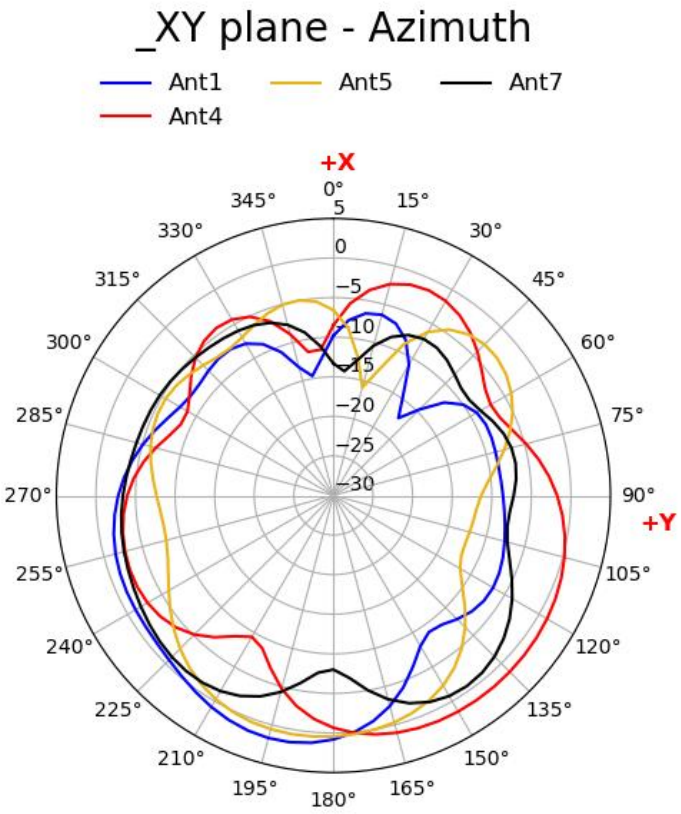
System Coverage - n66/B66/B4@1745MHz

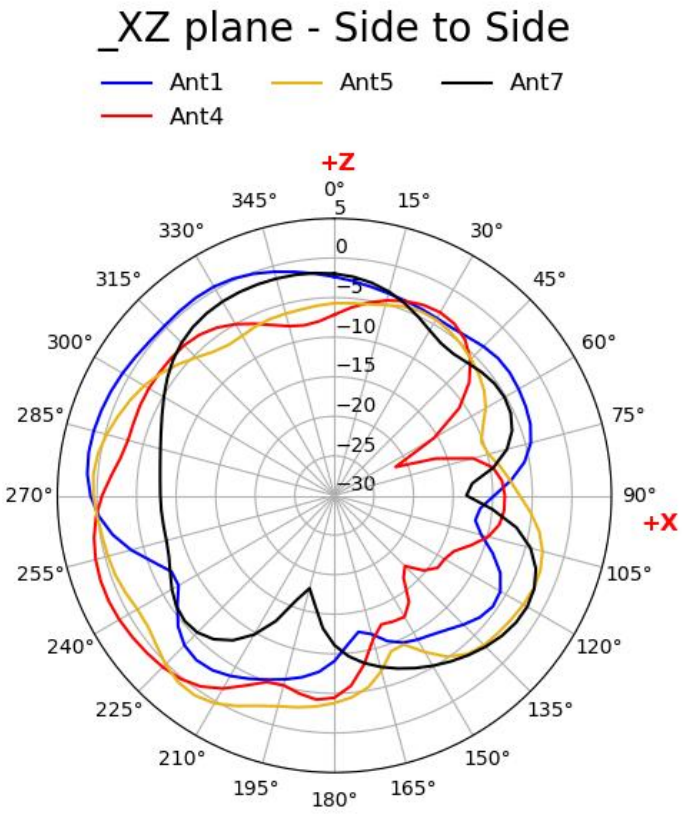


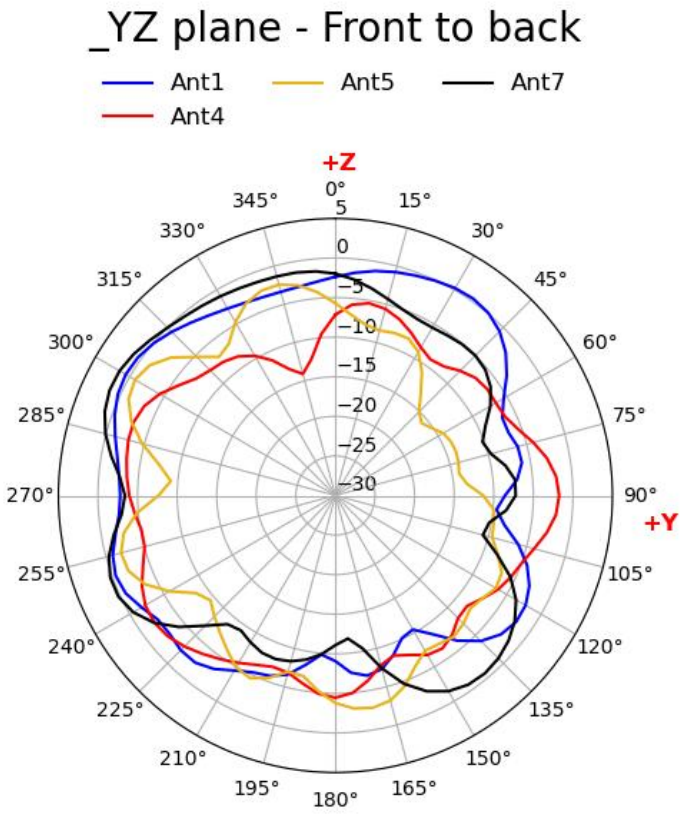




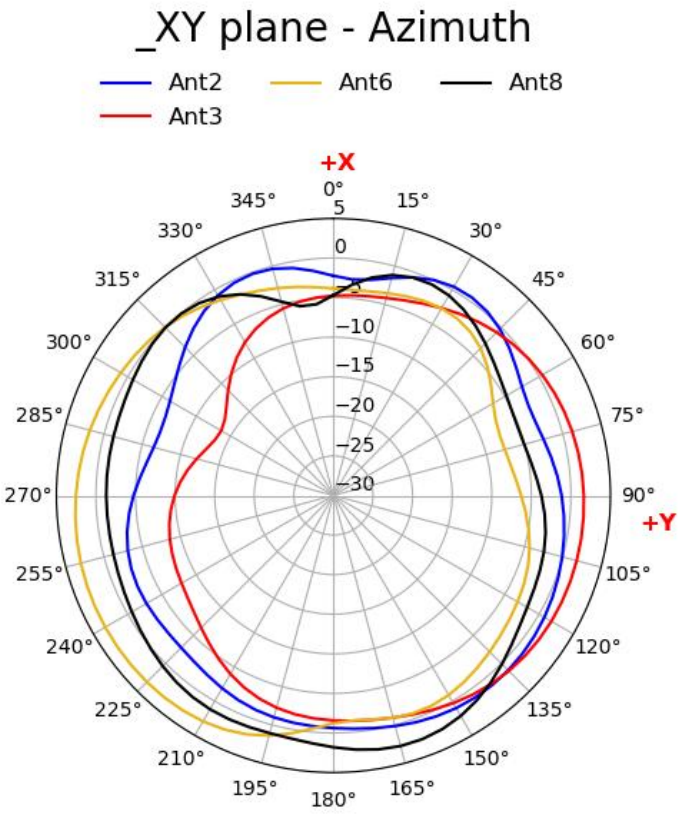
System Coverage - n2/B2/n25/B25@1880MHz

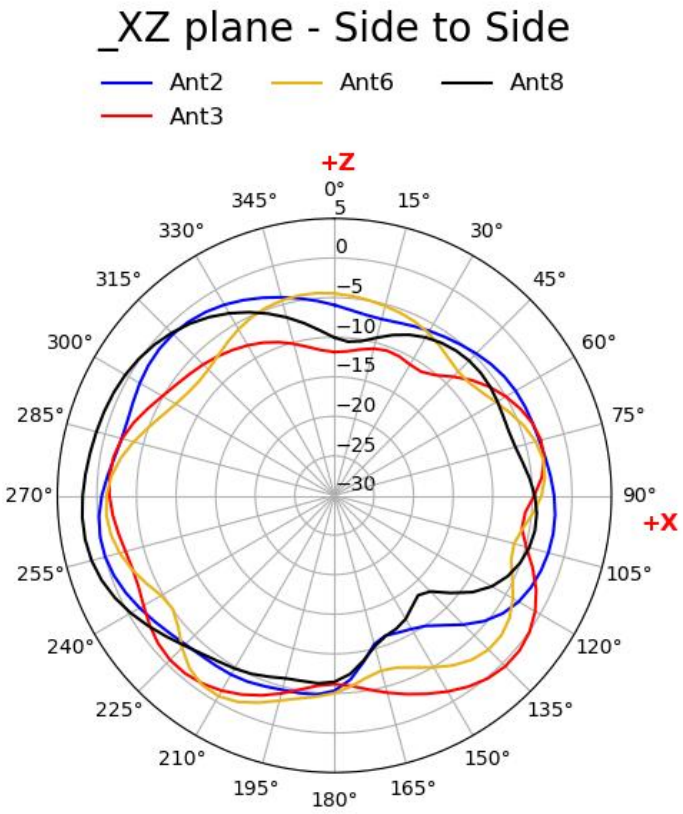


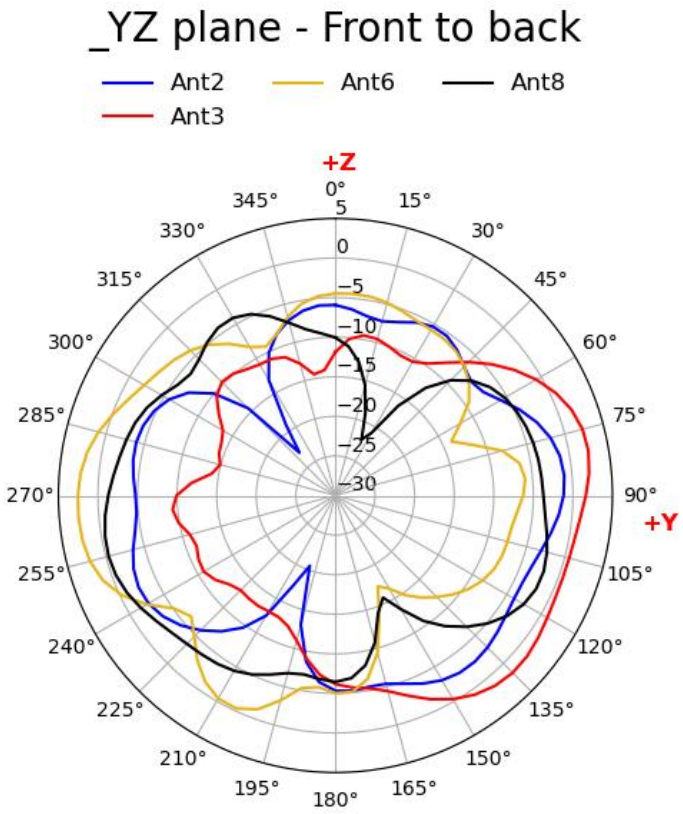




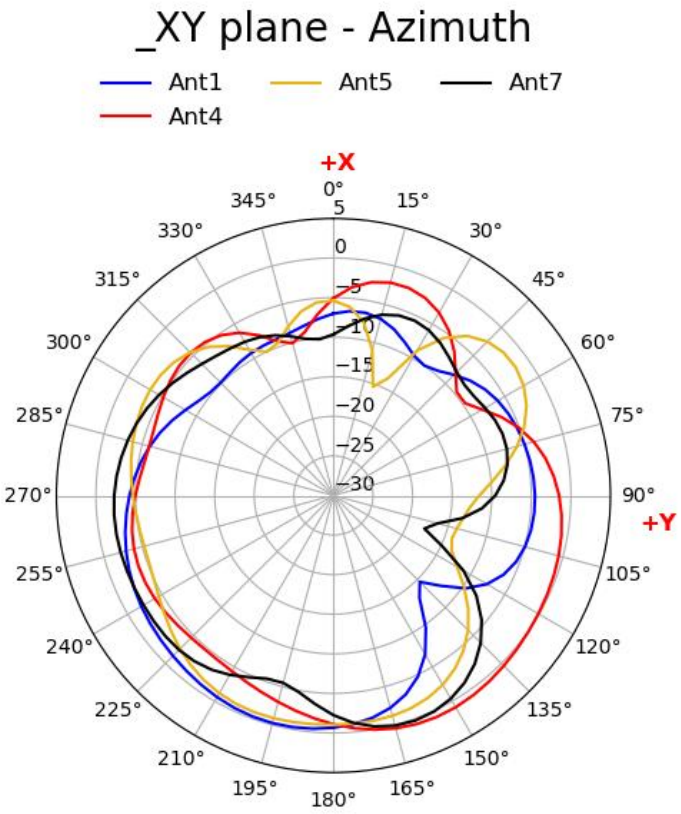
System Coverage - n2/B2/n25/B25@1880MHz

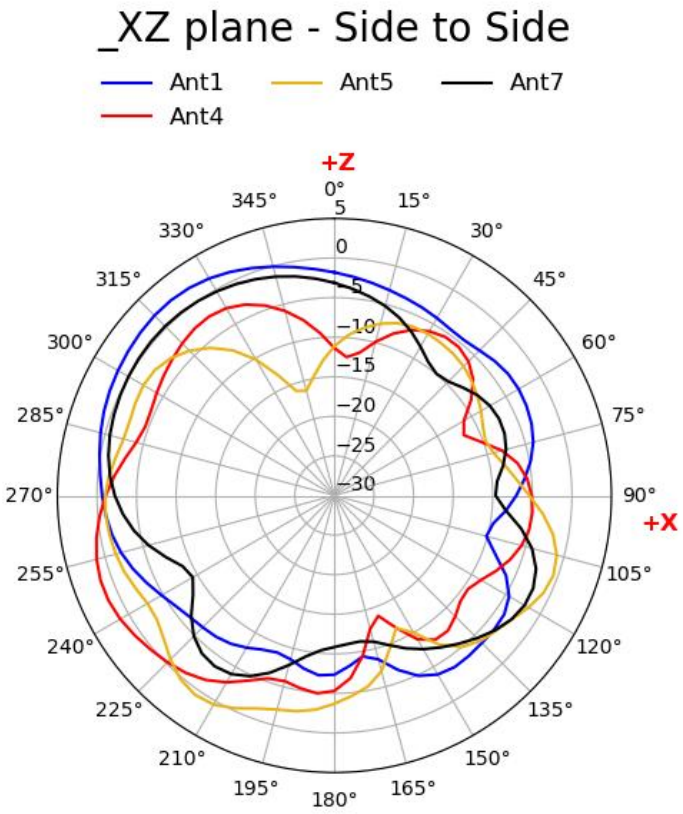


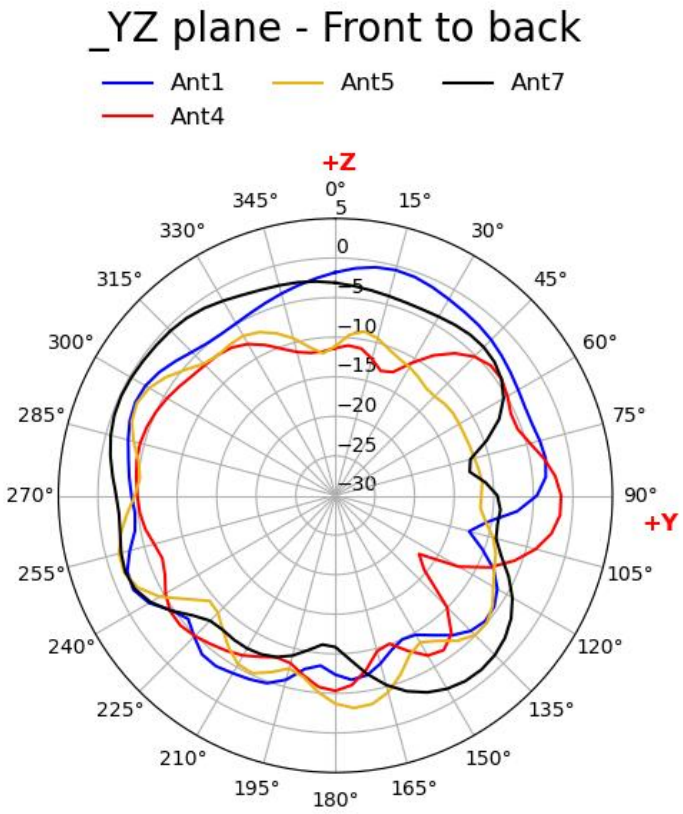




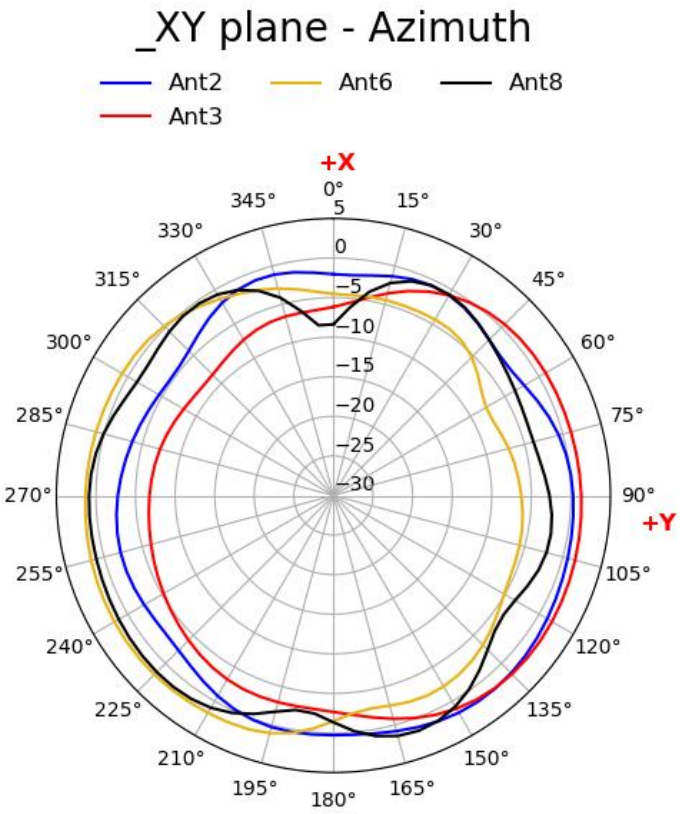
System Coverage - n2/B2/n25/B25@1960MHz

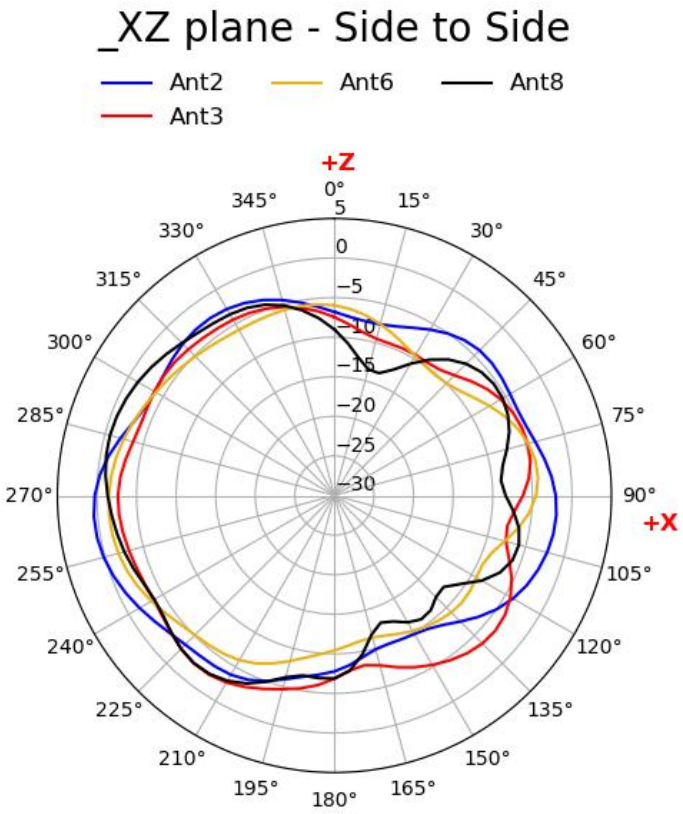


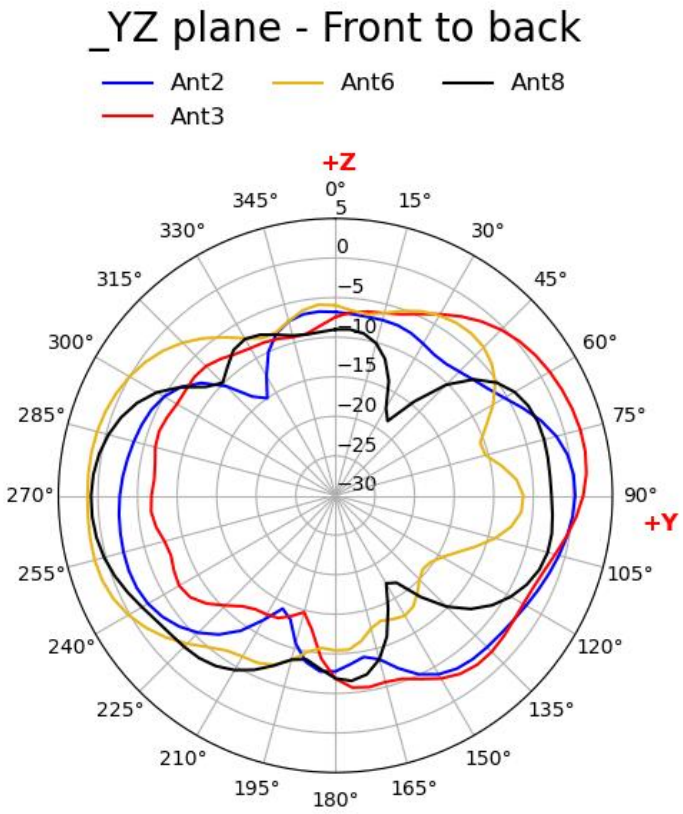




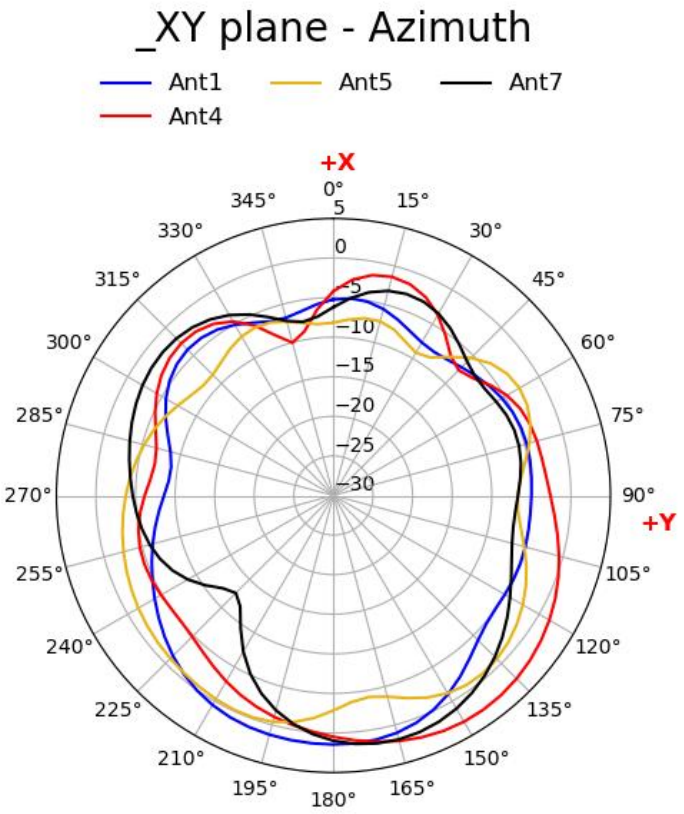
System Coverage - n2/B2/n25/B25@1960MHz

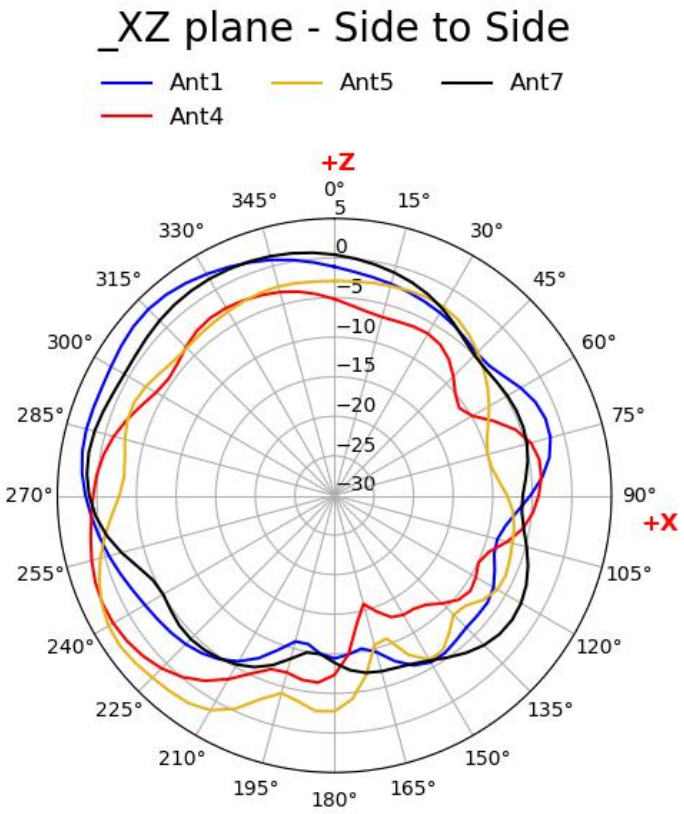


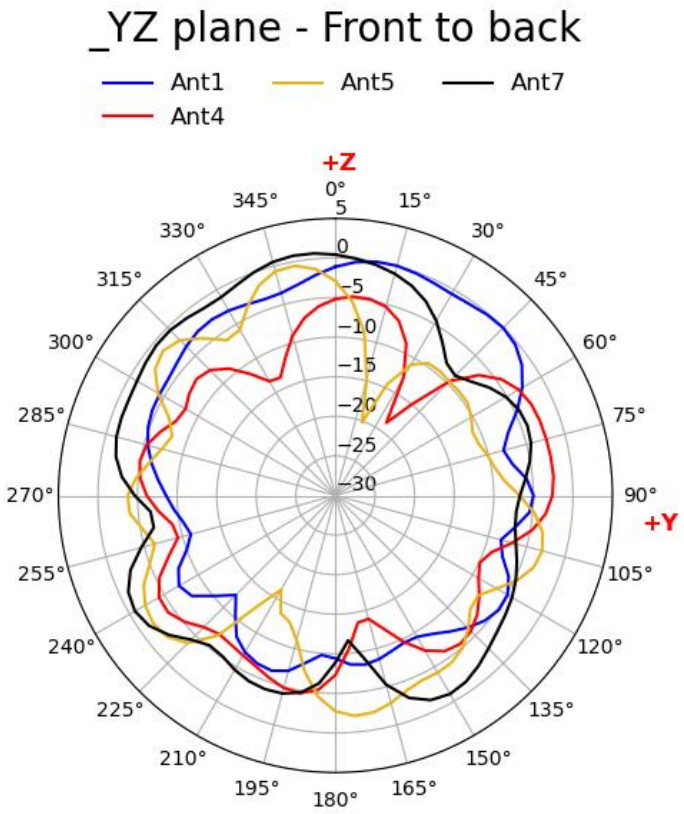




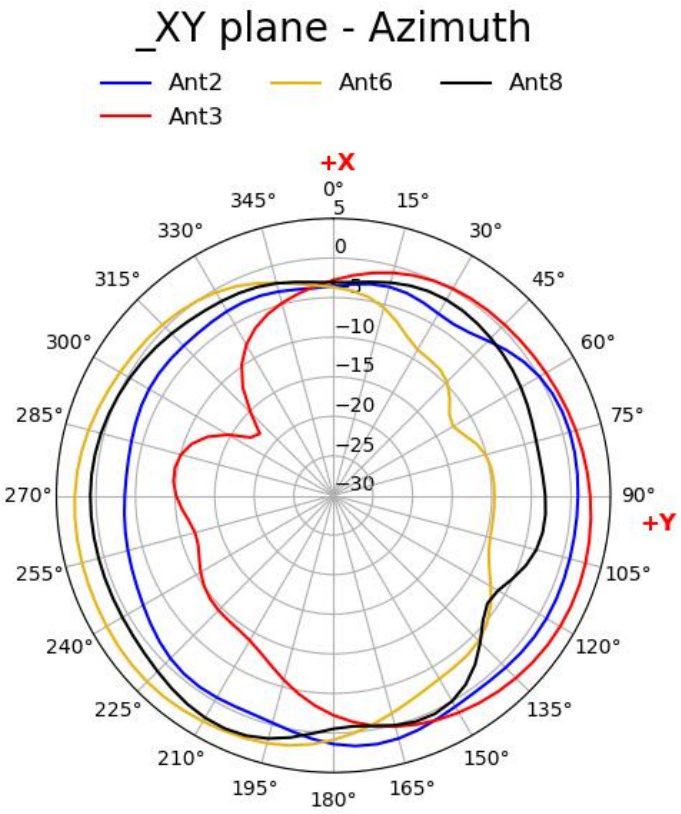
System Coverage - n66/B66/B4@2155MHz

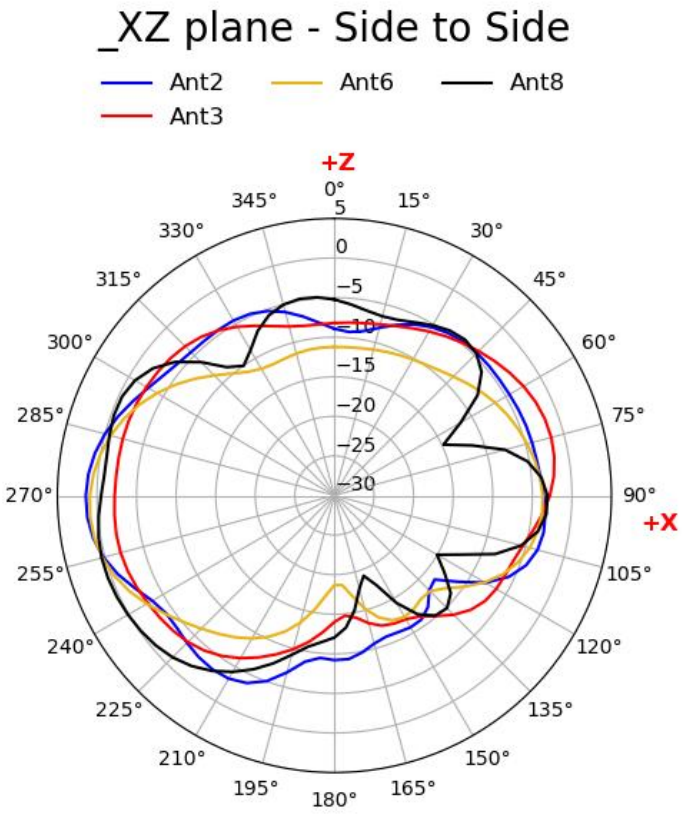


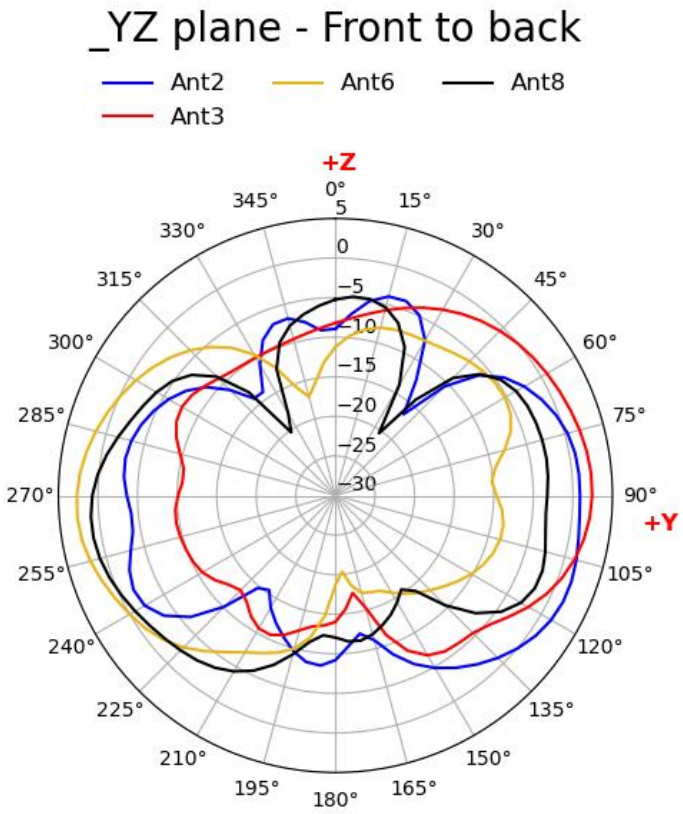




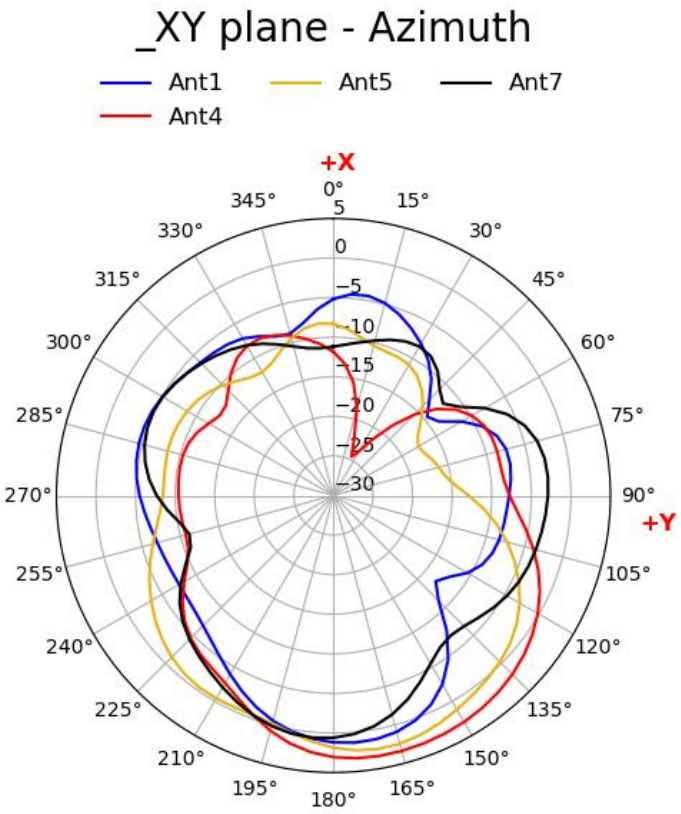
System Coverage - n66/B66/B4@2155MHz

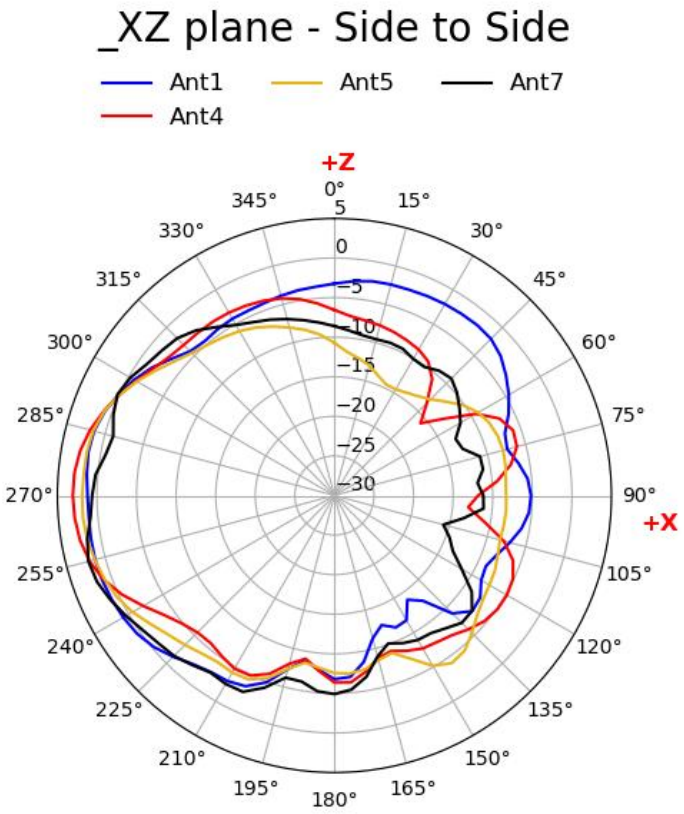


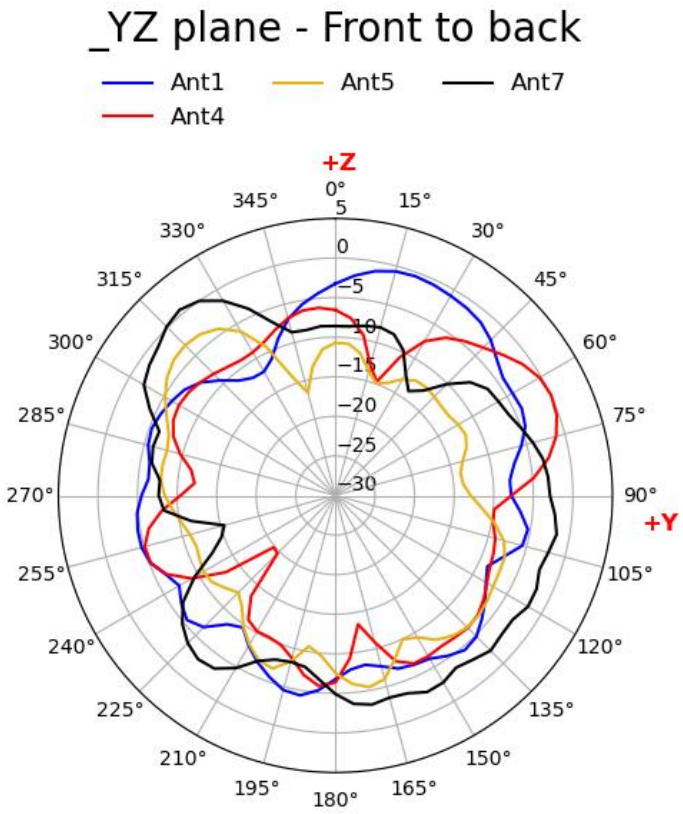




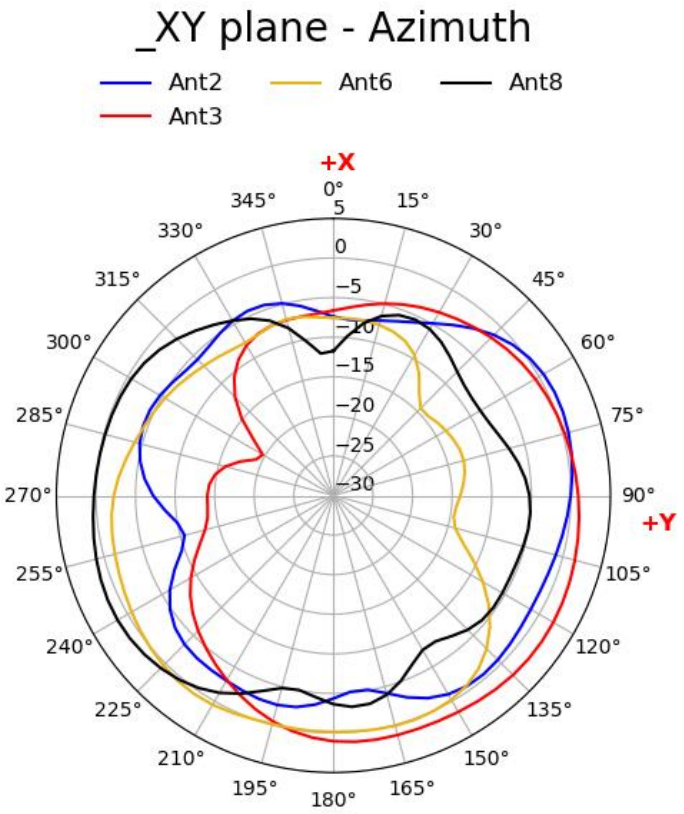
System Coverage - n41/B41@2600MHz

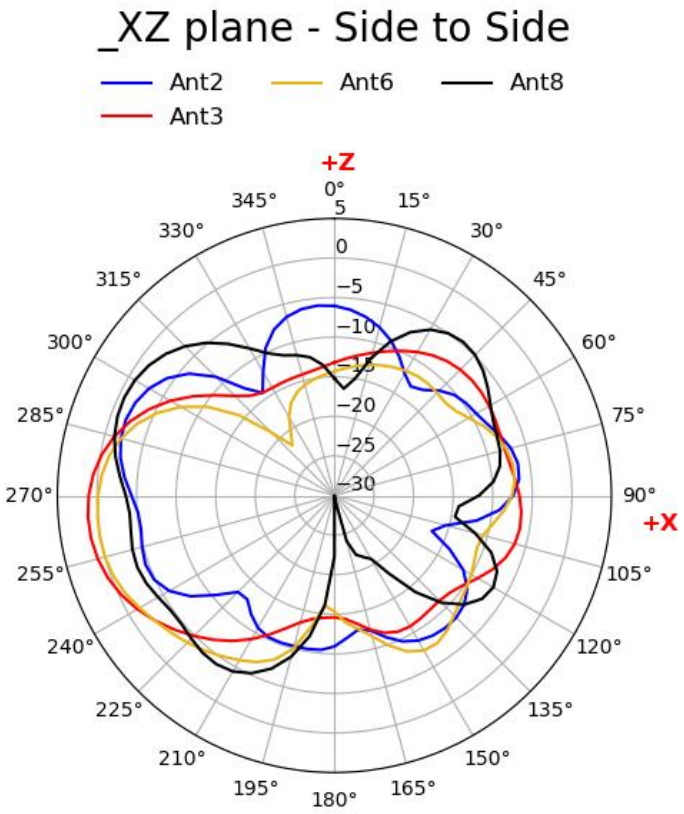


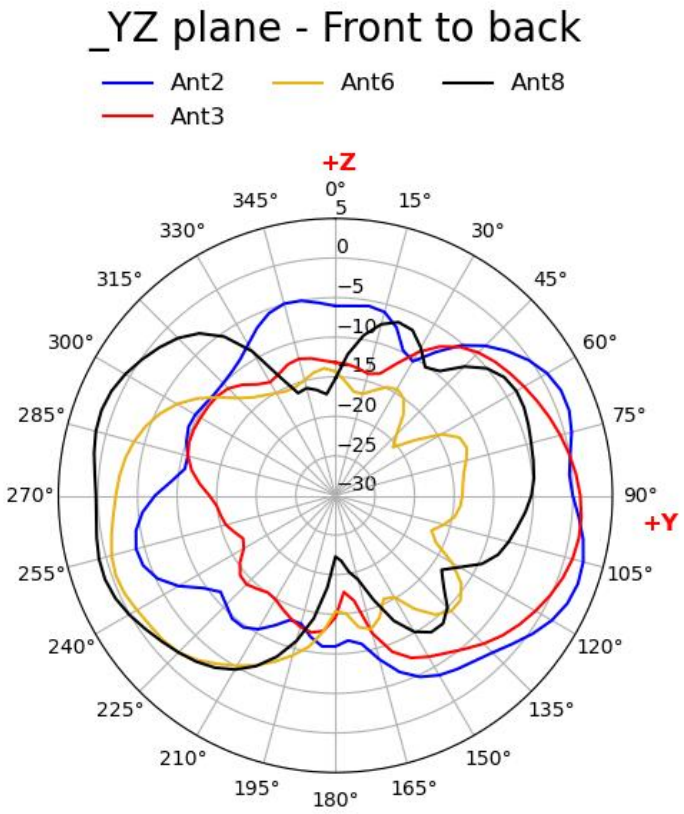




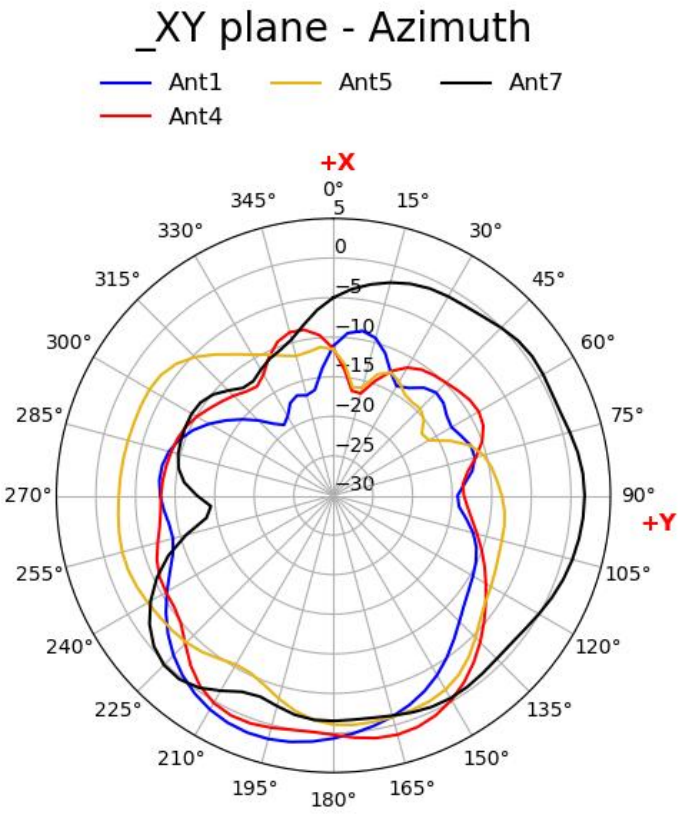
System Coverage - n41/B41@2600MHz

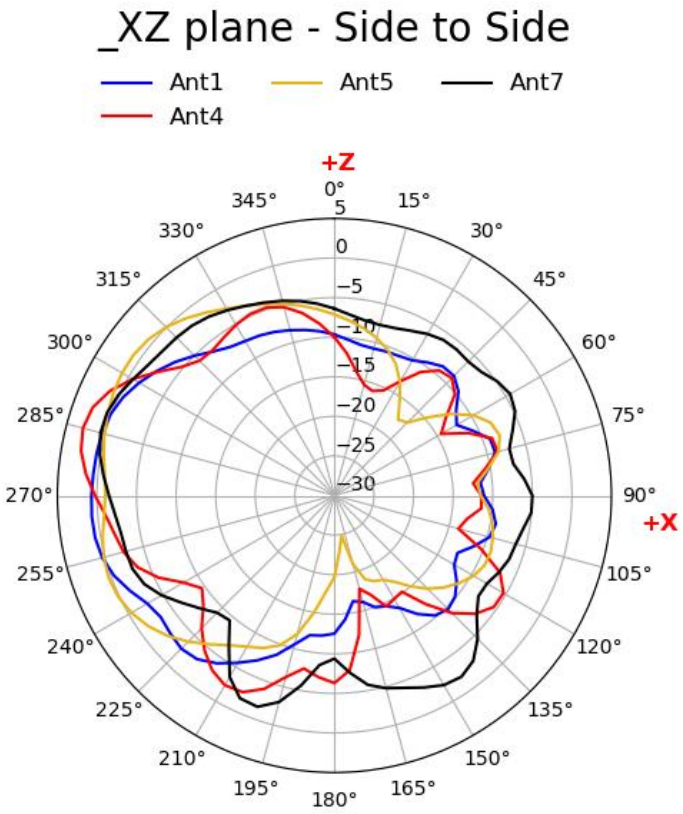


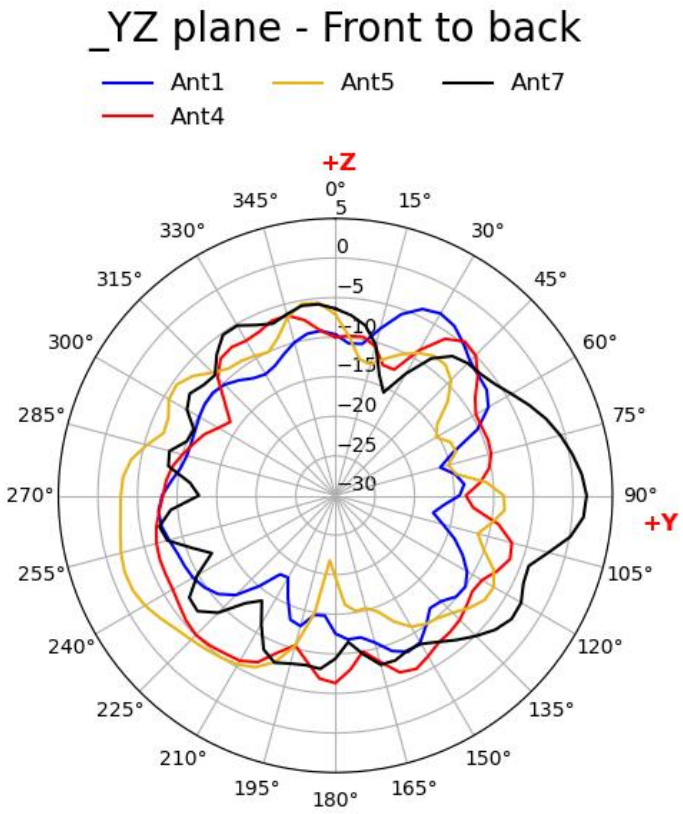




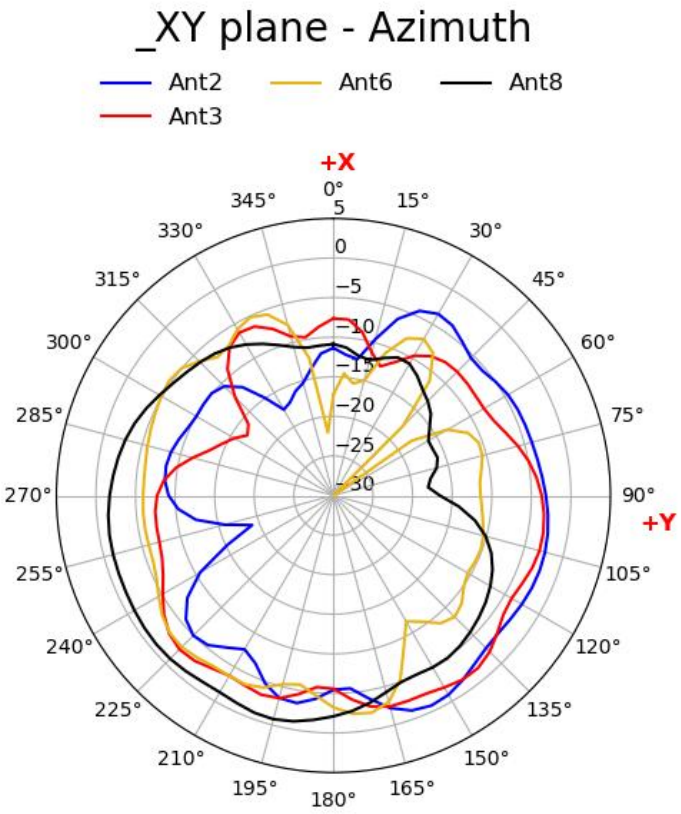
System Coverage - n77/B77/n48/B48@3750MHz

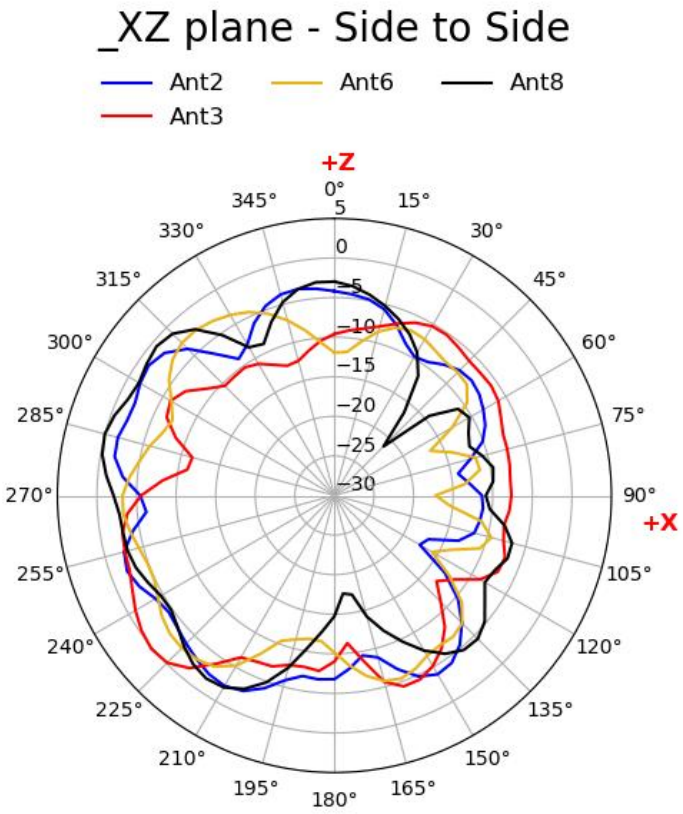


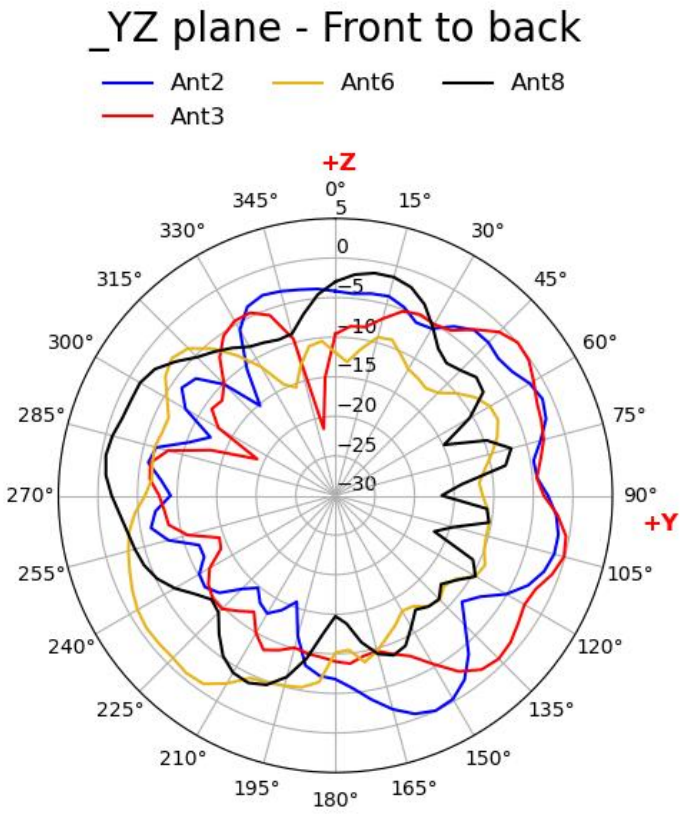




System Coverage - n77/B77/n48/B48@3750MHz







WiFi

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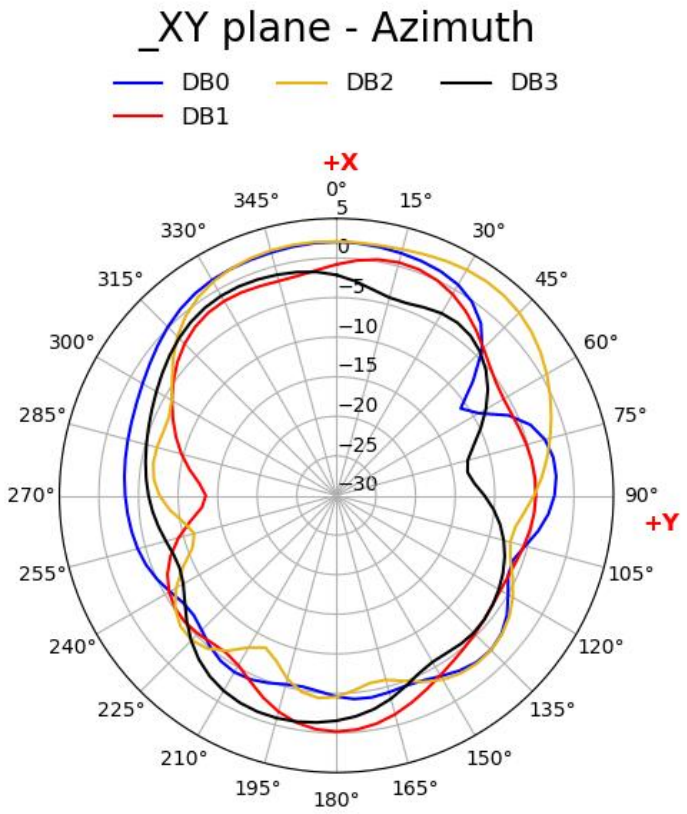
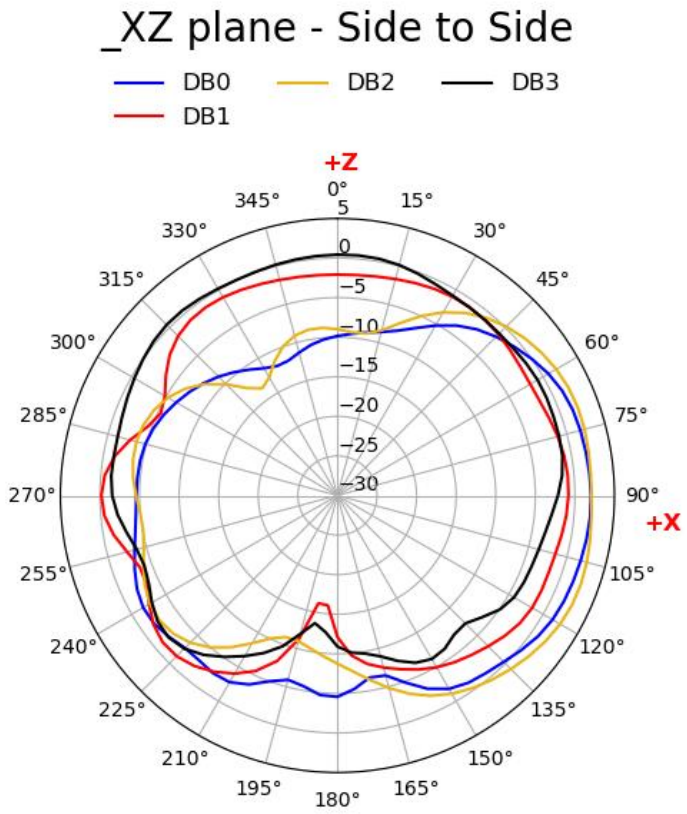
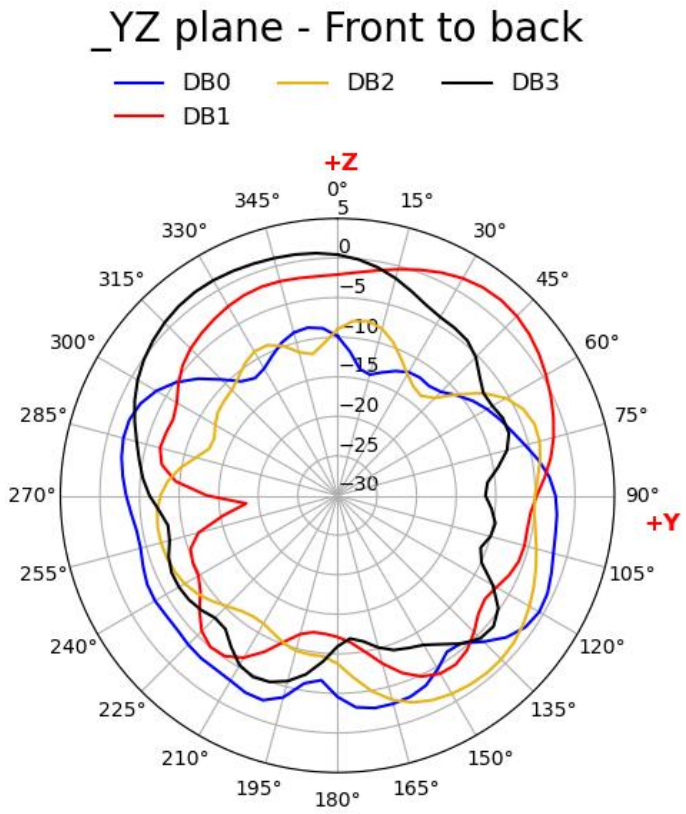
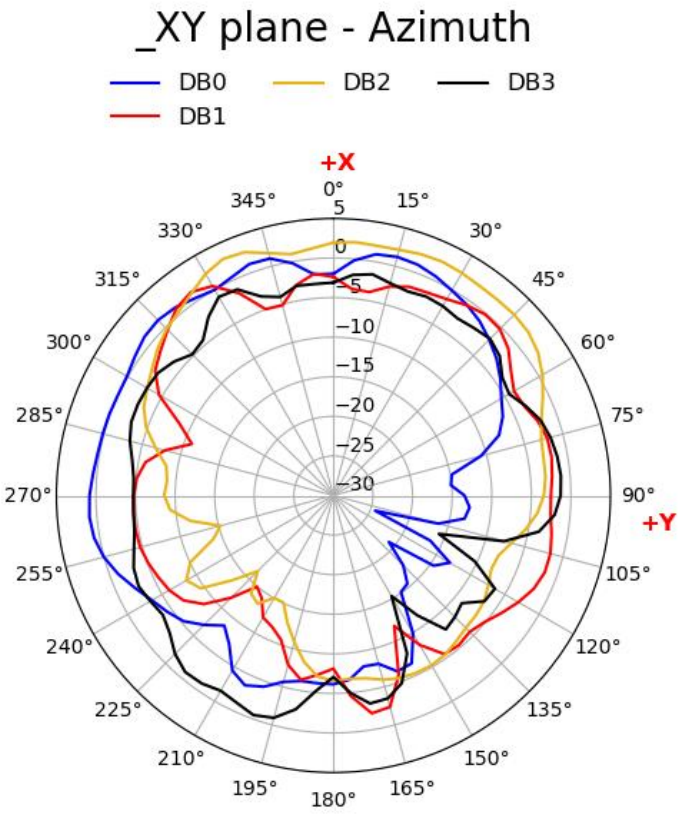
System Coverage - WiFi 2.4G@2450MHz

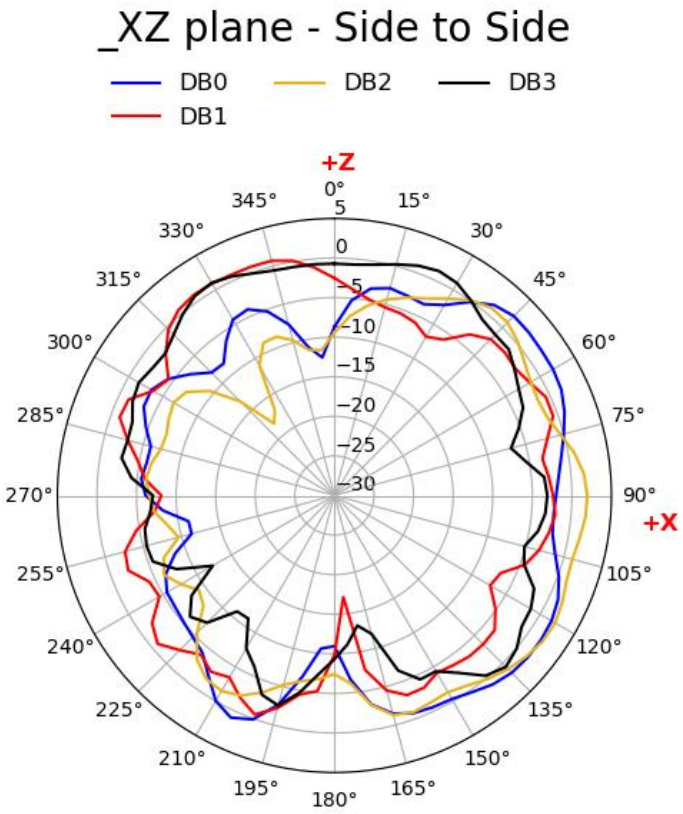


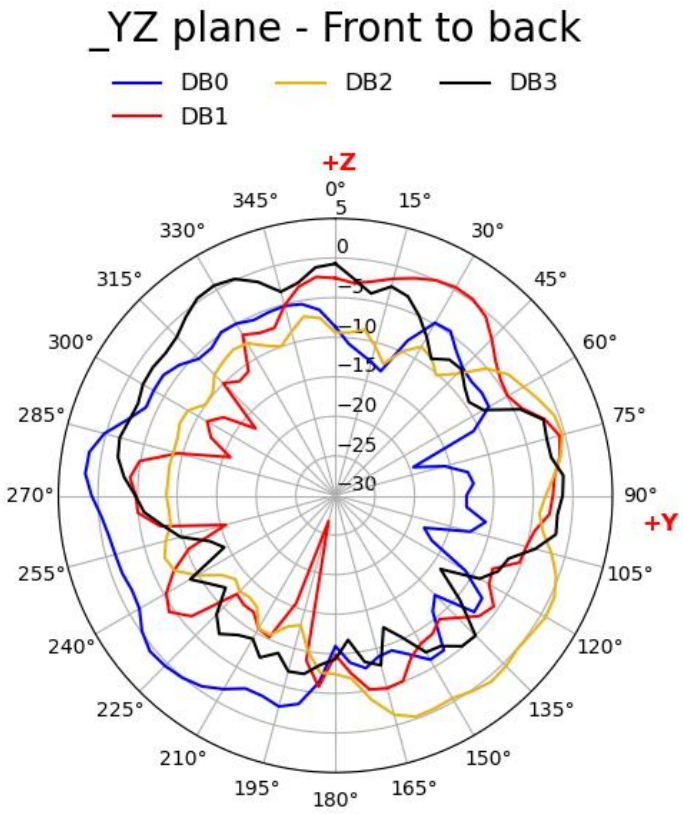




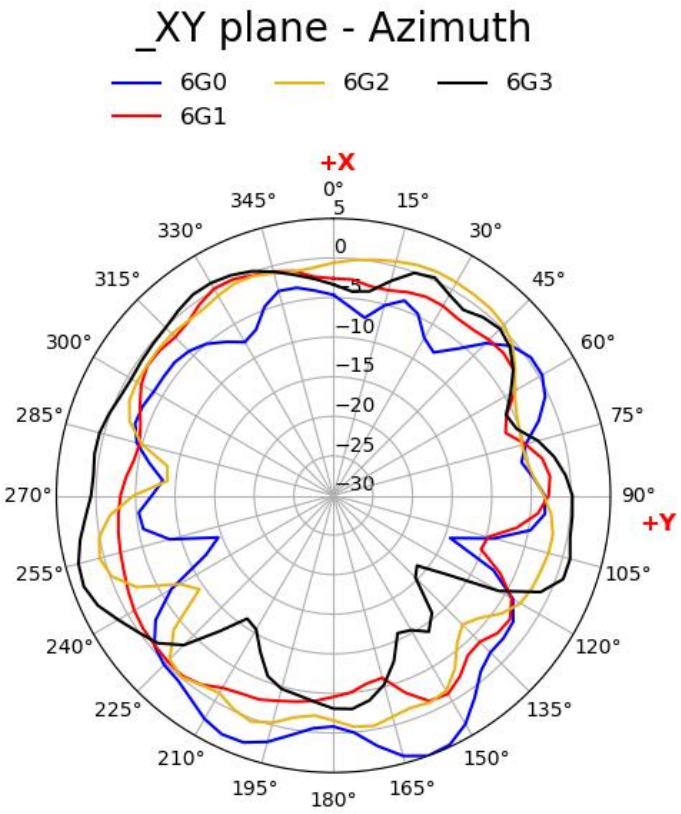
System Coverage - WiFi 5G@5500MHz

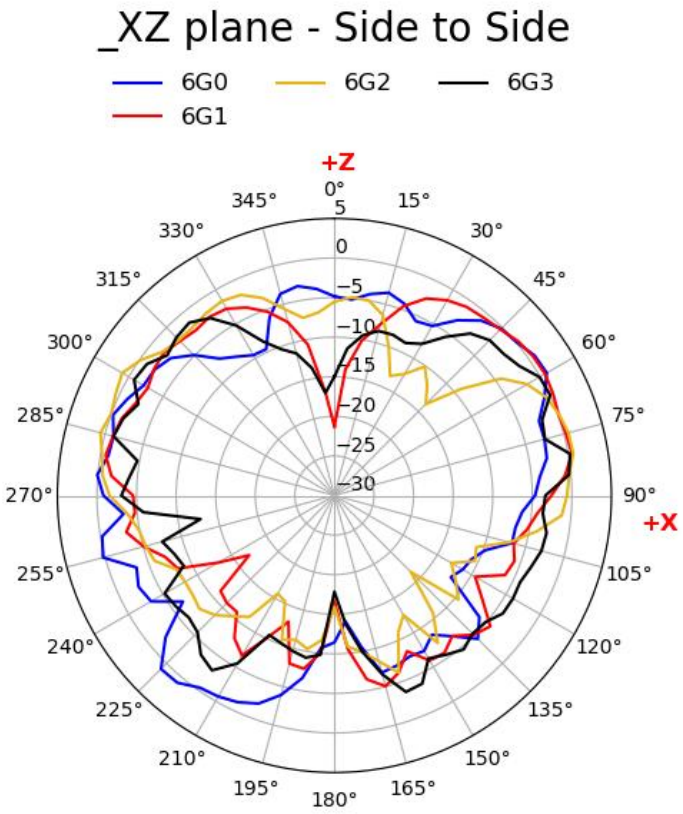


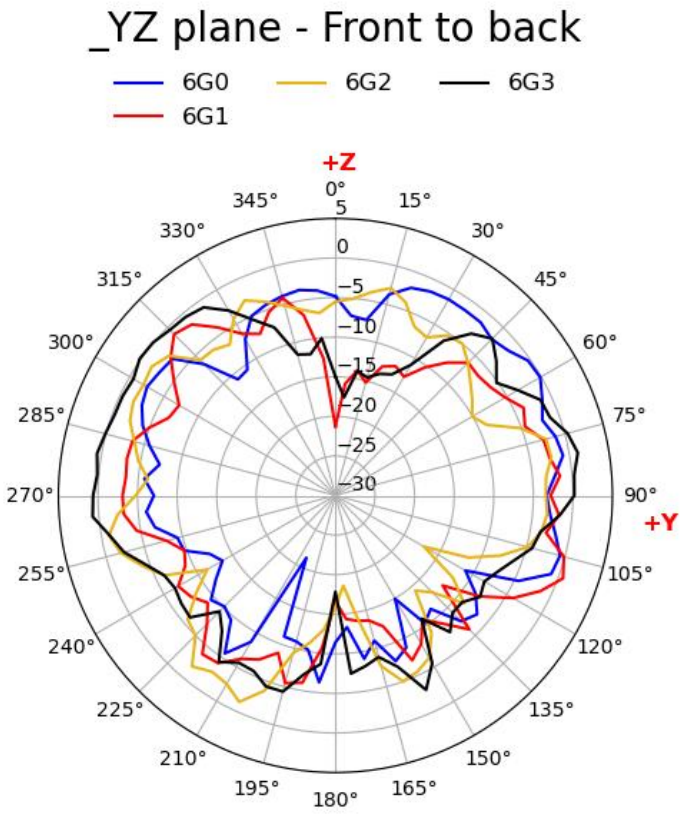




System Coverage - WiFi 6G@6500MHz







Others

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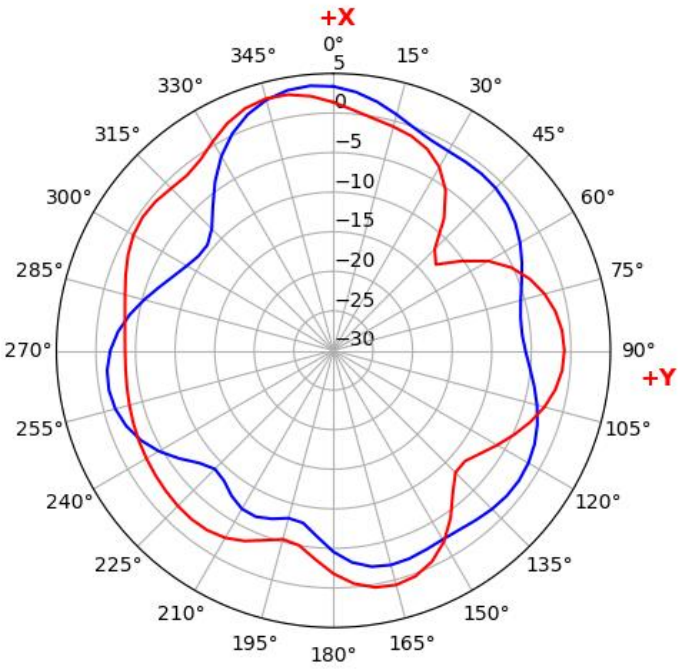
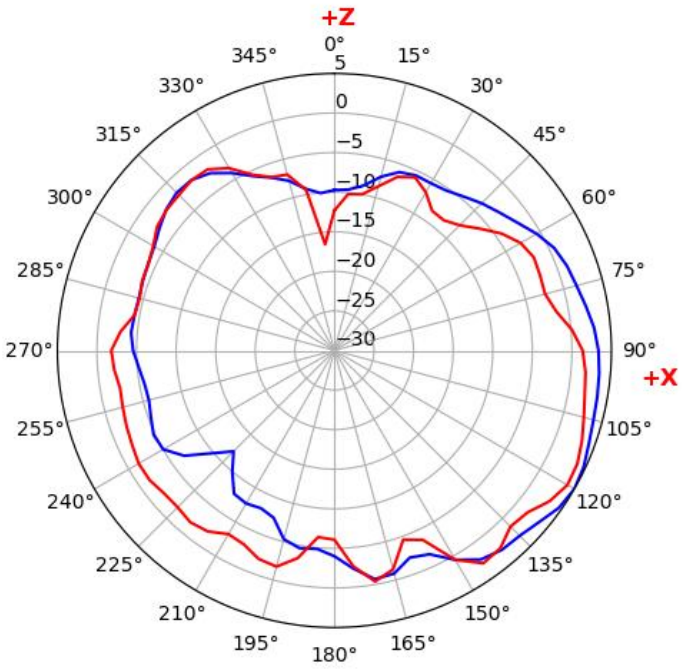
System Coverage - ZigBee&BT@2450MHz

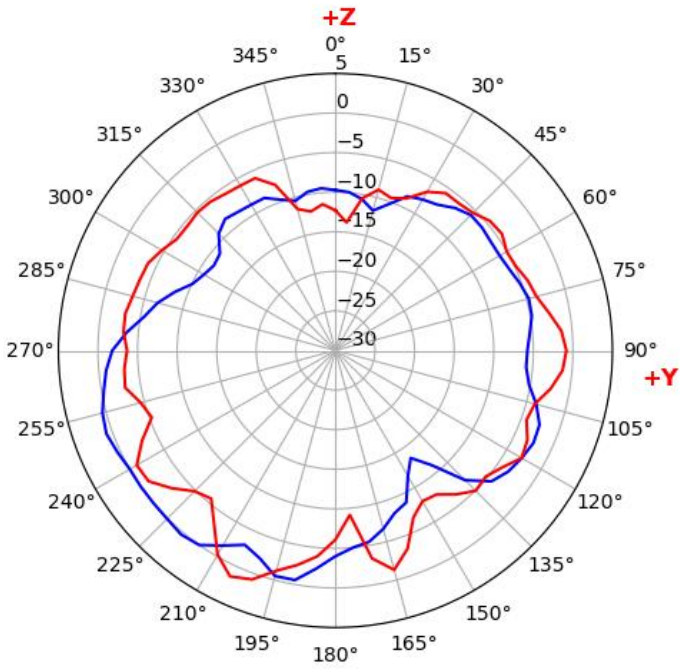
_XY plane - Azimuth



_XZ plane - Side to Side



_YZ plane - Front to back



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