Antenna Composite Gain Test Report

1. Test Information

Equipment	Campus Access Points
Brand Name	Aruba
Model Name	AP755
Applicant	Aruba
Manufacturer	Aruba

2. Testing Location

Testing Location	
WNC	ADD：20 Park Ave. ll, Hsinchu Science Park, Hsinchu 308 Taiwan

Test Condition	Test Engineer	Test Environment (^{O}C / %)	Test Date
Radiated	Leo Chuang	20-24 / 45-60	03.20.2024~04.03.2024

3. Test Frequency

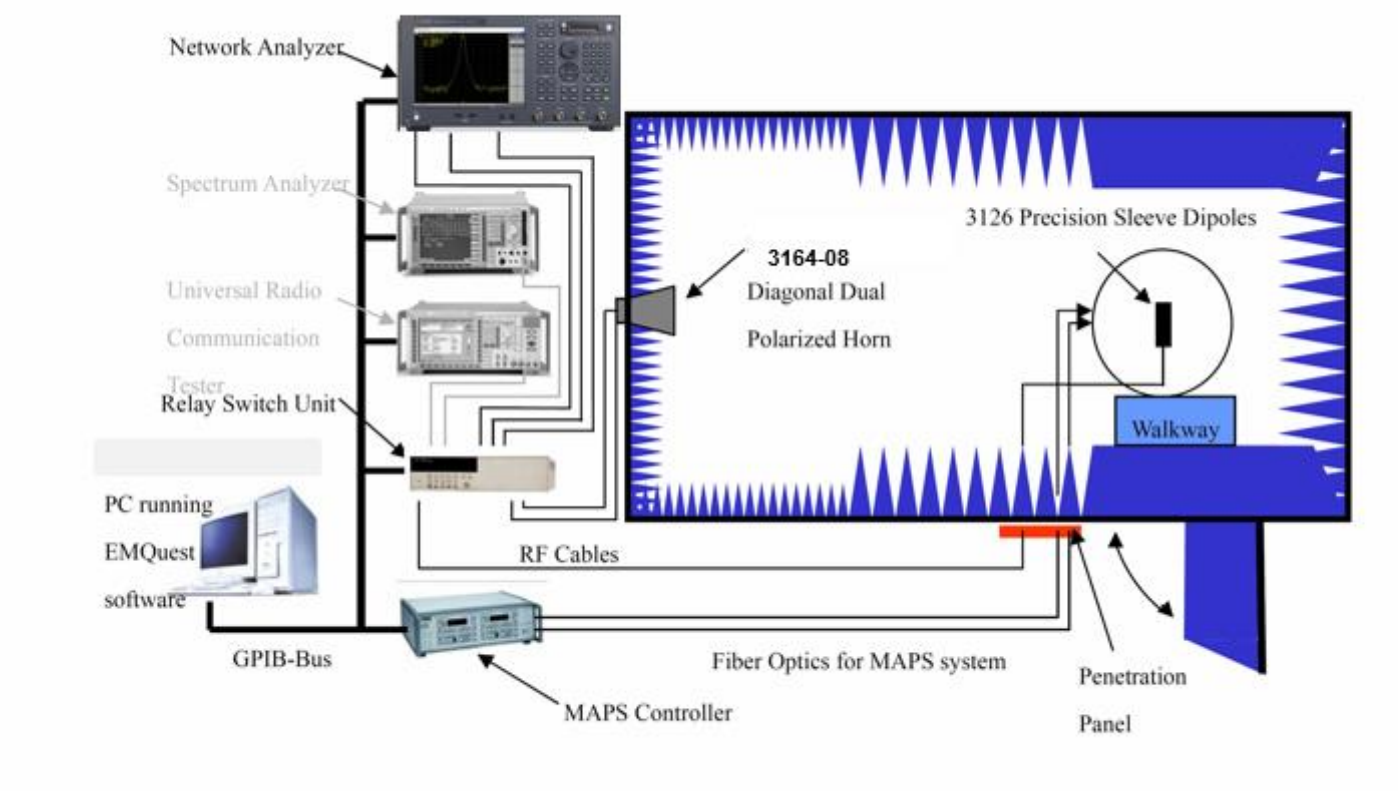
Band (MHz)	Test Frequency (MHz)
1165-1185	1176
1560-1590	1575
2401-2423	2401
2441-2463	2452
2473-2484	2484
5150-5250	5150
5470-5725	5550
5725-5850	5850
5850~5895	5850, 5895
5925-6425	5925
6425-6525	6555
6875-7125	7125

4. Antenna Information

Ant. Position	Brand Name	Model Name	Ant. Type	Connector
Antenna 1 (5G/6G)	Aruba	95XPAD15.G38	PIFA	I-PEX
Antenna 2 (5G/6G)	Aruba	95XPAD15.G39	PIFA	I-PEX
Antenna 3 (5G/6G)	Aruba	95XPAD15.G40	Alford Loop	I-PEX
Antenna 4 (5G/6G)	Aruba	95XPAD15.G41	Alford Loop	I-PEX
Antenna 5 (6G)	Aruba	95XPAD15.G42	Alford Loop	I-PEX
Antenna 6 (6G)	Aruba	95XPAD15.G43	Alford Loop	I-PEX
Antenna 7 (2G/6G)	Aruba	95XPAD15.G44	PIFA	I-PEX
Antenna 8 (2G/6G)	Aruba	95XPAD15.G45	PIFA	I-PEX

Antenna 9 (2G/5G/6G)	Aruba	95XPAD15.G46	Dipole	I-PEX
Antenna 10 (2G/5G/6G)	Aruba	95XPAD15.G47	Dipole	I-PEX
Antenna 11 (2G/5G/6G)	Aruba	95XPAD15.G48	PIFA	I-PEX
Antenna 12 (2G/5G/6G)	Aruba	95XPAD15.G49	PIFA	I-PEX
Antenna 13 (GPS)	Aruba	95XPAD15.G50	PIFA	I-PEX
Antenna 14 (BLE)	Aruba	95XPAD15.G51	Alford Loop	I-PEX

5. Test Configuration

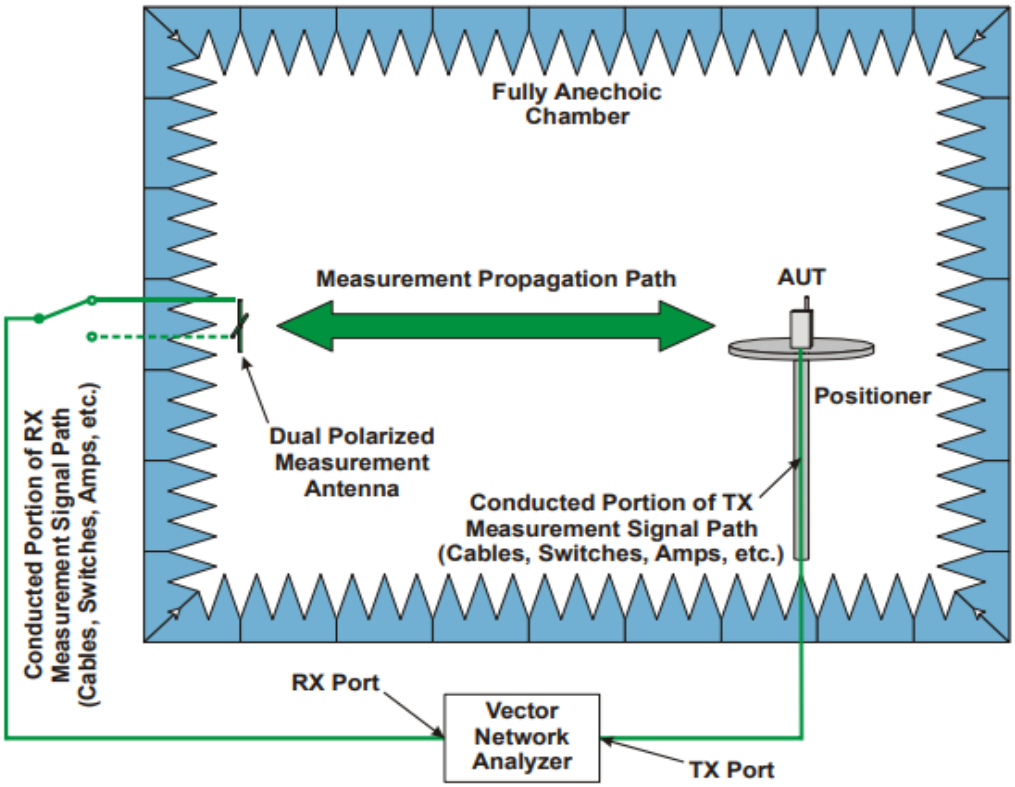


ETS-AMS 8500 System

Item	Device	Type/Model	Serial#	Manufacturer	Cal. Date	Cal. Due Date
1	Anechoic Chamber	ETS-AMS	8500	ETS-Lindgren	2024/03/09	2025/03/08
2	Turn Table	ETS		ETS-Lindgren	2024/03/09	2025/03/08
3	Multi-Device Positioning Controller	Model 2090	142407	ETS-Lindgren	2024/03/09	2025/03/08
4	Network Analyzer	E5071C	0171E5485A6J	Keysight	2023/05/31	2024/05/30
5	Horn antenna	3164-08	140264	ETS-Lindgren	2024/03/09	2025/03/08
6	Cable 7.5m 400MHz to 18GHz (H-pol)	SS402	00100A1F5A1XXS	Woken	2024/03/09	2025/03/08
7	Cable 7.5m 400MHz to 18GHz (V-pol)	SS402	00100A1F5A1XXS	Woken	2024/03/09	2025/03/08
8	Cable 14m 400MHz to 18GHz	SS402	00100A1F5A1XXS	Woken	2024/03/09	2025/03/08
9	Temperature & Humidity Meter	HTC-01		Metravi	2024/03/09	2025/03/08

6. Reference Calibration

Range Calibration Configuration (Passive)



7. Test Method

The “great circle” cut method, whereby the Measurement Antenna remains fixed and the EUT is rotated about two axes in sequential order.The radiated RF performance of the Equipment Under Test (EUT) is measured by sampling the radiated transmit power of the mobile at various locations surrounding the device. A three-dimensional characterization of the 'transmit' performance of the EUT is pieced together by analyzing the data from the spatially distributed measurements.

Data points taken every 15 degrees in the theta and in the phi axes are deemed sufficient to fully characterize the EUT's Far-Field radiation pattern and total radiated power All of the measured power values will be integrated

8. Measured Values and Calculation of Correlated / Uncorrelated Gains

Antenna Peak Gain Table (Ant. Position：5G/6G Ant.1~4)

Band (MHz)	5150-5470	5470-5725	5725-5850	5850~5895	
Frequency (MHz)	5150	5550	5850	5850	5895
Ant.1 Max Gain (dBi)	3.7	5.5	5.4	5.4	5.5
Ant.2 Max Gain (dBi)	3.4	5.8	4.4	4.4	4.5
Ant.3 Max Gain (dBi)	3.8	4.4	3.5	3.5	4.2
Ant.4 Max Gain (dBi)	4.7	4.6	4.1	4.1	4.1
Max Gain (dBi)	4.7	5.8	5.4	5.4	5.5

Band (MHz)	5925-6425	6425-6525	6525-7125
Frequency (MHz)	5925	6555	7125
Ant.1 Max Gain (dBi)	5.1	5.3	6.0
Ant.2 Max Gain (dBi)	4.8	5.8	4.8
Ant.3 Max Gain (dBi)	4.6	3.6	3.3
Ant.4 Max Gain (dBi)	4.0	4.3	3.0
Max Gain (dBi)	5.1	5.8	6.0

Antenna Peak Gain Table (Ant. Position：6G Ant.5~8)

Band (MHz)	5925-6425	6425-6525	6525-7125
Frequency (MHz)	5925	6555	7125
Ant.5 Max Gain (dBi)	4.4	4.3	4.6
Ant.6 Max Gain (dBi)	4.1	4.6	4.6
Ant.7 Max Gain (dBi)	5.9	5.4	5.7
Ant.8 Max Gain (dBi)	5.2	5.7	5.3
Max Gain (dBi)	5.9	5.7	5.7

Antenna Peak Gain Table (Ant. Position：2G/5G/6G Ant.9~12)

Band (MHz)	2401-2423	2441-2463	2473-2484
Frequency (MHz)	2401	2452	2484
Ant.9 Max Gain (dBi)	4.8	5.0	4.7
Ant.10 Max Gain (dBi)	4.5	5.0	5.2
Ant.11 Max Gain (dBi)	2.3	3.6	4.1
Ant.12 Max Gain (dBi)	2.8	3.2	3.2
Max Gain (dBi)	4.8	5.0	5.2

Band (MHz)	5150-5470	5470-5725	5725-5850	5850~5895	
Frequency (MHz)	5150	5550	5850	5850	5895
Ant.9 Max Gain (dBi)	4.4	5.6	5.6	5.6	5.7
Ant.10 Max Gain (dBi)	4.9	5.1	5.0	5.0	4.4
Ant.11 Max Gain (dBi)	4.6	3.6	4.0	4.0	4.0
Ant.12 Max Gain (dBi)	3.9	4.7	5.4	5.4	5.7
Max Gain (dBi)	4.9	5.6	5.6	5.6	5.7

Band (MHz)	5925-6425	6425-6525	6525-7125
Frequency (MHz)	5925	6555	7125
Ant.9 Max Gain (dBi)	5.6	5.7	5.3
Ant.10 Max Gain (dBi)	4.6	5.2	5.0
Ant.11 Max Gain (dBi)	4.5	3.3	4.2
Ant.12 Max Gain (dBi)	4.7	4.1	5.0
Max Gain (dBi)	5.6	5.7	5.3

Antenna Peak Gain Table (Ant. Position：GPS Ant.13)

Band (MHz)	1165-1185	1560-1590
Frequency (MHz)	1176	1575
Ant.13 Max Gain (dBi)	2.9	3.3

Antenna Peak Gain Table (Ant. Position：BLE Ant.7~8, 14)

Band (MHz)	2401-2423	2441-2463	2473-2484
Frequency (MHz)	2401	2452	2484
Ant.7 Max Gain (dBi)	2.9	3.9	4.4
Ant.8 Max Gain (dBi)	2.1	2.1	2.1
Ant.14 Max Gain (dBi)	5.2	5.7	5.3
Max Gain (dBi)	5.2	5.7	5.3

Antenna Correlated / Uncorrelated Gain Table (Ant. Position：5G/6G Ant.1~4)

Frequency (MHz)	Correlated Gain (dBi)	Uncorrelated Gain (dBi)
5150	8.4	2.7
5550	9.5	3.6
5850	9.0	3.0
5895	8.1	2.4
5925	8.1	2.4
6555	9.2	3.2
7125	8.5	2.8

Antenna Correlated / Uncorrelated Gain Table (Ant. Position：6G Ant.5~8)

Frequency (MHz)	Correlated Gain (dBi)	Uncorrelated Gain (dBi)
5925	9.1	3.1
6555	9.0	3.0
7125	9.4	3.6

Antenna Correlated / Uncorrelated Gain Table (Ant. Position：2G/5G/6G Ant.9~12)

Frequency (MHz)	Correlated Gain (dBi)	Uncorrelated Gain (dBi)
2401	8.2	2.4
2452	8.7	2.9
2484	9.0	3.1
5150	9.5	3.5
5550	9.5	3.6
5850	9.6	3.7
5895	9.2	3.4
5925	9.4	3.6
6555	9.5	3.6
7125	8.7	3.0

Antenna Correlated / Uncorrelated Gain Table (Ant. Position：BLE Ant.7, 14)

Frequency (MHz)	Correlated Gain (dBi)	Uncorrelated Gain (dBi)
2401	6.6	3.7
2452	7.2	4.2
2484	7.1	4.1

Antenna Correlated / Uncorrelated Gain Table (Ant. Position：BLE Ant.7, 8)

Frequency (MHz)	Correlated Gain (dBi)	Uncorrelated Gain (dBi)
2401	4.9	2.0
2452	5.2	2.3
2484	5.5	2.7

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 raw antenna data is located in the appendix of this report.

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

The uncorrelated and correlated gains were calculated for each point in the spatial data, and the highest values reported.

Note：

KDB 662911 D01, F(2)(d)(i)

$$\text{Correlated Gain} = 10\log\left[\left(10^{\frac{G1}{20}} + 10^{\frac{G2}{20}} + \cdots + 10^{\frac{Gn}{20}}\right)^2 / N_{Ant.}\right] dBi$$

KDB 662911 D01, F(2)(d)(ii)

$$\text{Uncorrelated Gain} = 10\log\left[\left(10^{\frac{G1}{10}} + 10^{\frac{G2}{10}} + \cdots + 10^{\frac{Gn}{10}}\right) / N_{Ant.}\right] dBi$$

$N_{Ant.}$：Number of antenna

G_n：Gain of antenna

Maximum Correlated / Uncorrelated Gain Calculation
(Ant. Position：5G/6G Ant.1~4)

Frequency (MHz)	5550	6555
Ant.1 Gain (dBi)	4.37	1.02
Ant.2 Gain (dBi)	3.57	3.92
Ant.3 Gain (dBi)	4.12	3.32
Ant.4 Gain (dBi)	1.84	4.02
Phi (°)	160	325
Theta (°)	50	45
Corr. Ant. Gain (dBi) $[10^{(G_1/20)}+10^{(G_2/20)}]^2/N_{ANT.}$	9.02	8.26
Uncor. Ant. Gain (dBi) $[10^{(G_1/10)}+10^{(G_2/10)}]/N_{ANT.}$	2.28	2.10
Corr. Gain (dBi) 10*log(Corr. Ant. Gain)	9.5	9.2
Uncor. Gain (dBi) 10*log(Uncor. Ant. Gain)	3.6	3.2

(Ant. Position：6G Ant.5~8)

Frequency (MHz)	7125
Ant.5 Gain (dBi)	2.68
Ant.6 Gain (dBi)	0.67
Ant.7 Gain (dBi)	5.44
Ant.8 Gain (dBi)	4.19
Phi (°)	340
Theta (°)	45
Corr. Ant. Gain (dBi) $[10^{(G_1/20)}+10^{(G_2/20)}]^2/N_{ANT.}$	8.80
Uncor. Ant. Gain (dBi) $[10^{(G_1/10)}+10^{(G_2/10)}]/N_{ANT.}$	2.29
Corr. Gain (dBi) 10*log(Corr. Ant. Gain)	9.4
Uncor. Gain (dBi) 10*log(Uncor. Ant. Gain)	3.6

(Ant. Position：2G/5G/6G Ant.9~12)

Frequency (MHz)	2484	5850	6555
Ant.9 Gain (dBi)	2.08	5.39	5.01
Ant.10 Gain (dBi)	4.73	3.93	4.55
Ant.11 Gain (dBi)	2.00	1.63	1.88
Ant.12 Gain (dBi)	2.80	2.99	2.17
Phi (°)	215	5	315
Theta (°)	40	15	5
Corr. Ant. Gain (dBi) $[10^{(G_1/20)}+10^{(G_2/20)}]^2/N_{ANT.}$	7.93	9.15	8.98
Uncor. Ant. Gain (dBi) $[10^{(G_1/10)}+10^{(G_2/10)}]/N_{ANT.}$	2.02	2.35	2.30
Corr. Gain (dBi) 10*log(Corr. Ant. Gain)	9.0	9.6	9.5
Uncor. Gain (dBi) 10*log(Uncor. Ant. Gain)	3.1	3.7	3.6

(Ant. Position：BLE Ant.7, 14)

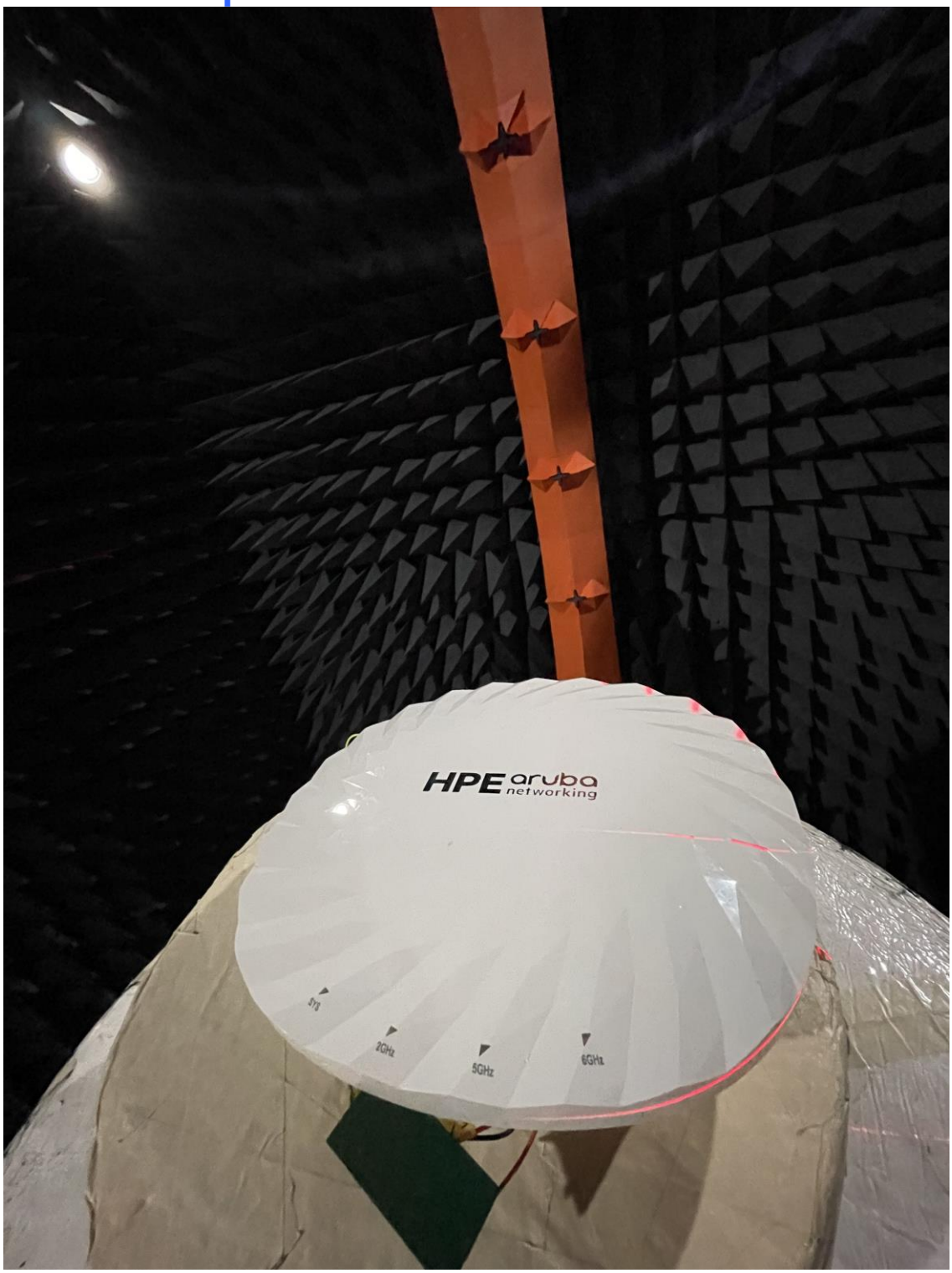
Frequency (MHz)	2452
Ant.7 Gain (dBi)	3.52
Ant.14 Gain (dBi)	4.78
Phi (°)	150
Theta (°)	50
Corr. Ant. Gain (dBi) $[10^{(G_1/20)}+10^{(G_2/20)}]^2/N_{ANT.}$	5.22
Uncor. Ant. Gain (dBi) $[10^{(G_1/10)}+10^{(G_2/10)}]/N_{ANT.}$	2.63
Corr. Gain (dBi) 10*log(Corr. Ant. Gain)	7.2
Uncor. Gain (dBi) 10*log(Uncor. Ant. Gain)	4.2

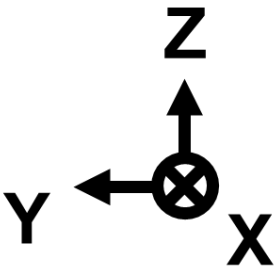
(Ant. Position：BLE Ant.7~8)

Frequency (MHz)	2484
Ant.7 Gain (dBi)	4.13
Ant.8 Gain (dBi)	0.50
Phi (°)	165
Theta (°)	55
Corr. Ant. Gain (dBi) $[10^{(G_1/20)}+10^{(G_2/20)}]^2/N_{ANT.}$	3.56
Uncor. Ant. Gain (dBi) $[10^{(G_1/10)}+10^{(G_2/10)}]/N_{ANT.}$	1.85
Corr. Gain (dBi) 10*log(Corr. Ant. Gain)	5.5
Uncor. Gain (dBi) 10*log(Uncor. Ant. Gain)	2.7

Note：Antenna gain is the correlated / uncorrelated gain position in the appendix gain table.

9. Test Setup



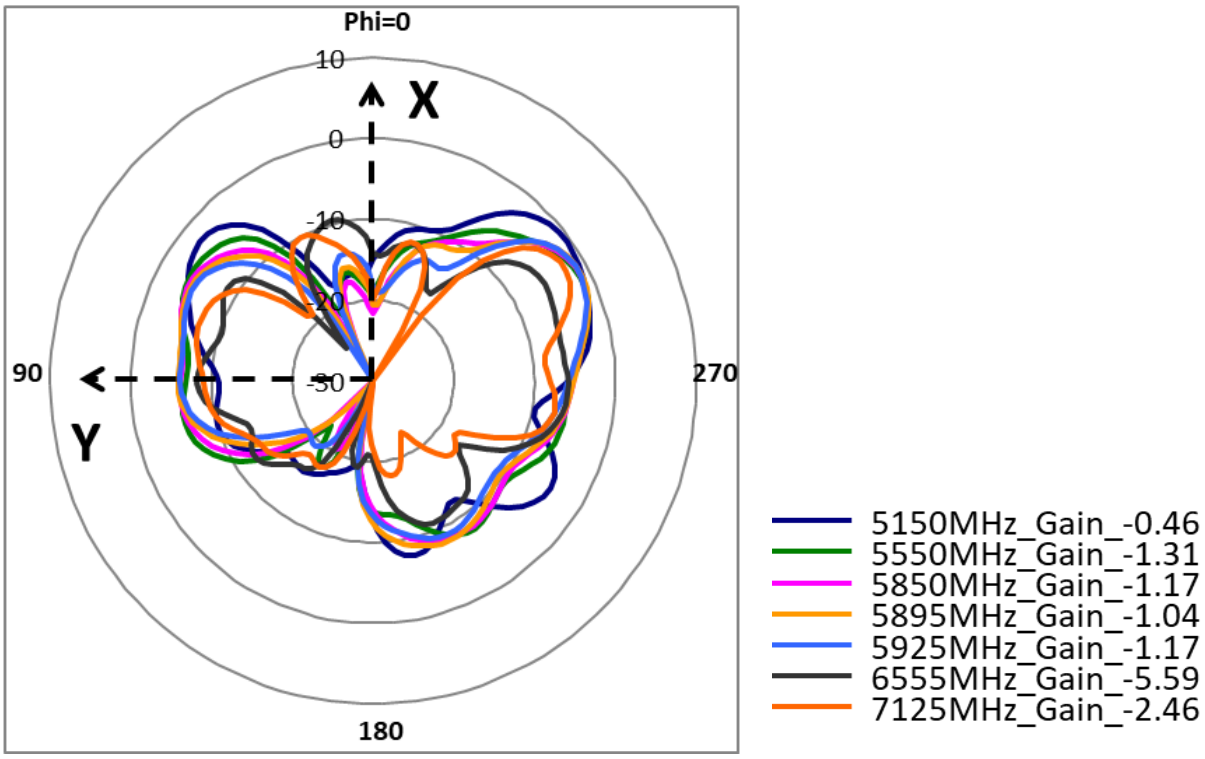


Note：
Top cover toward +Z direction

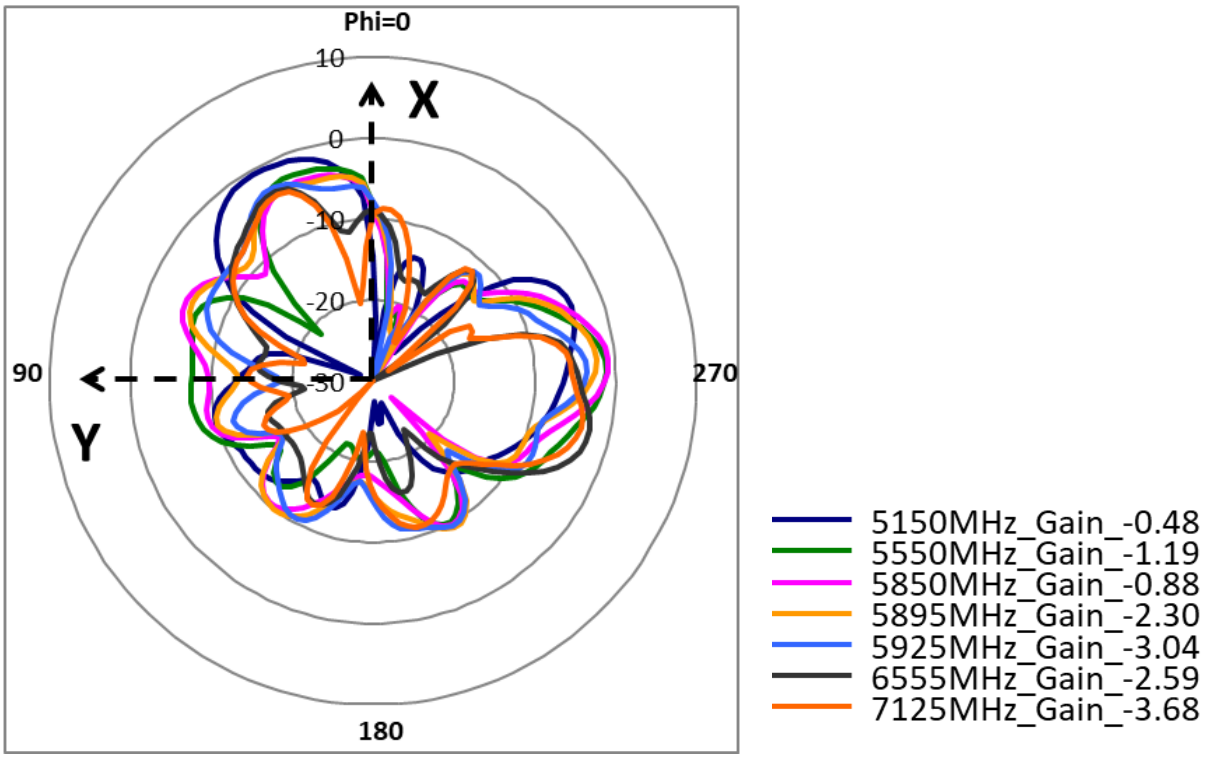
10. Radiation Pattern

Ant. Position：5G/6G Ant.1~4

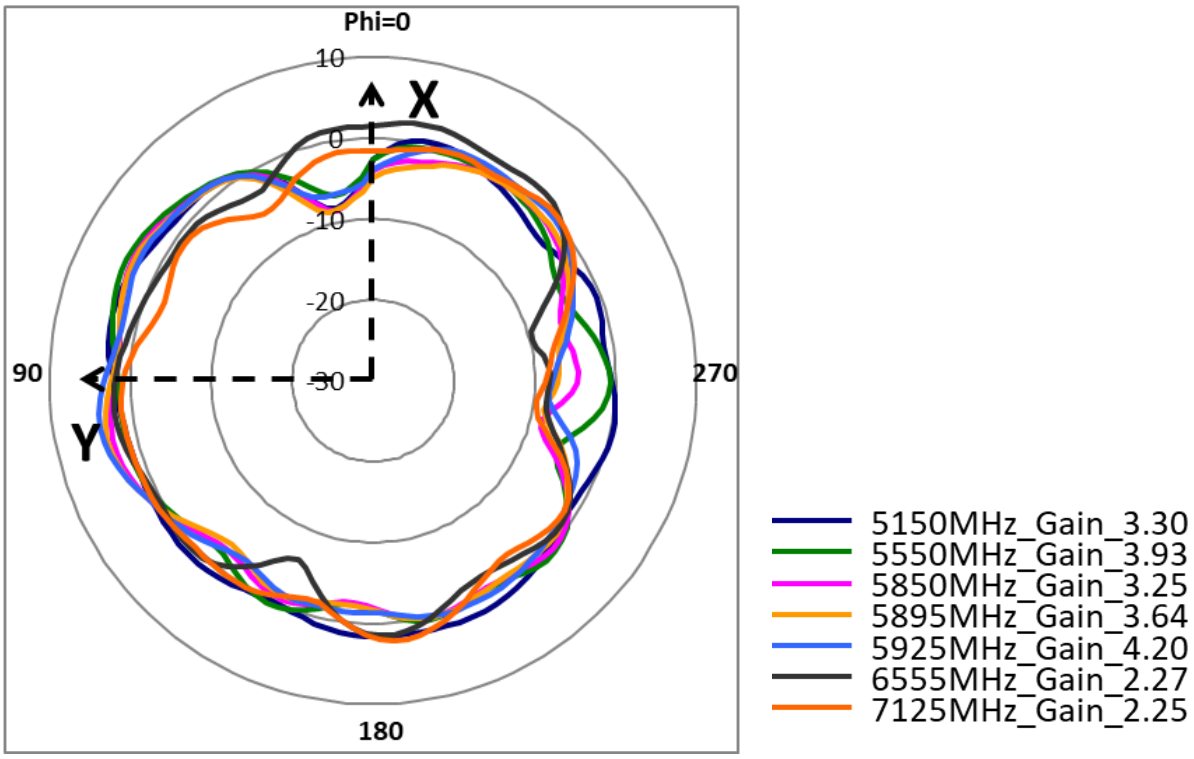
XY_Pol._Phi_Ant.1



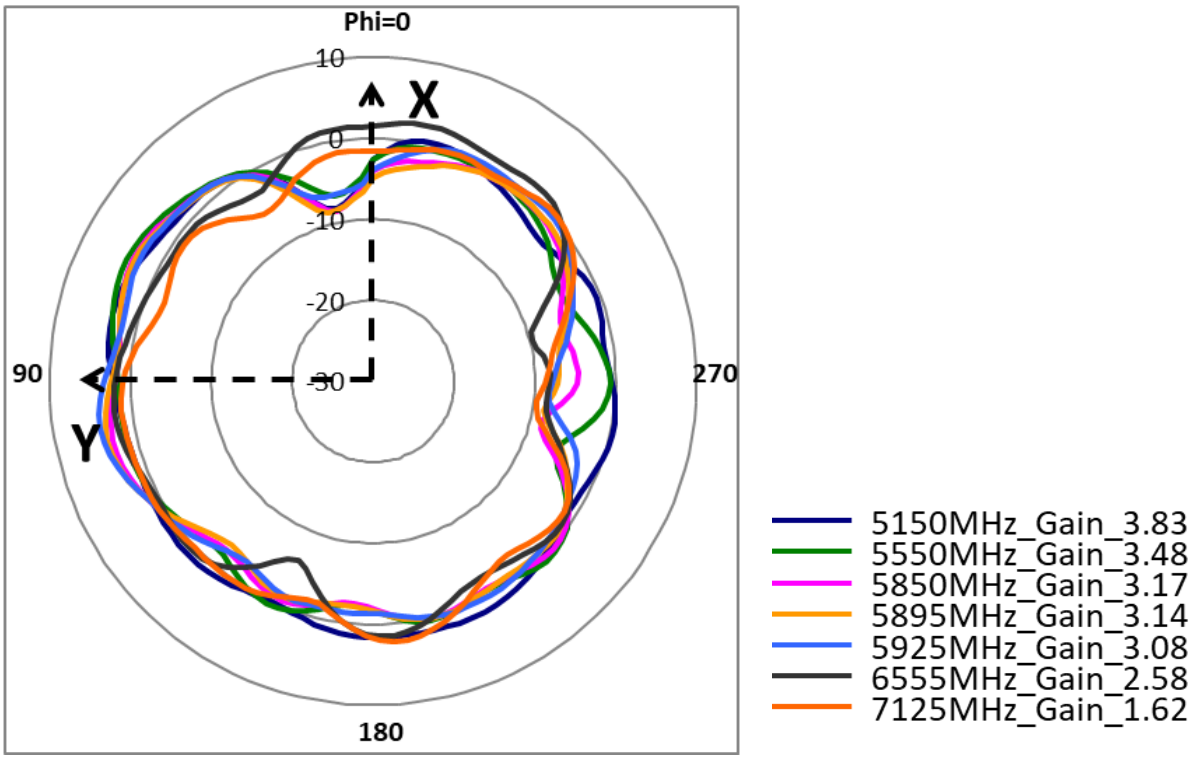
XY_Pol._Phi_Ant.2



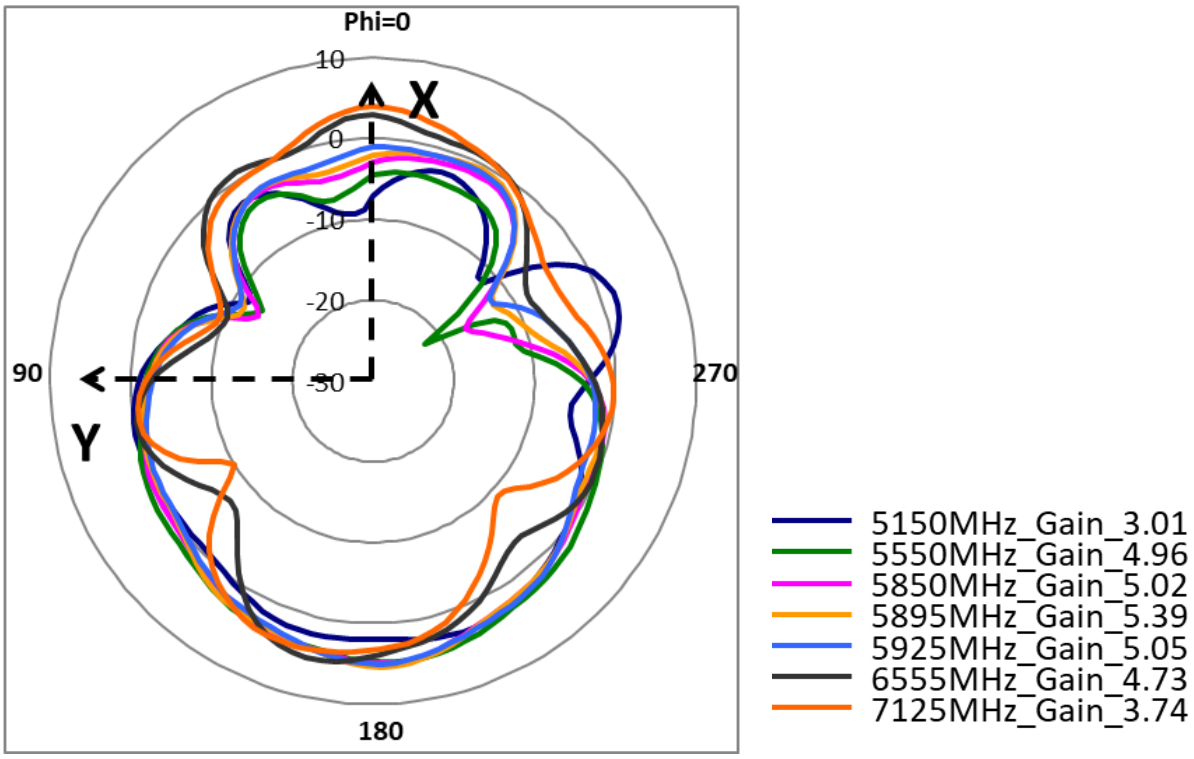
XY_Pol._Phi_Ant.3



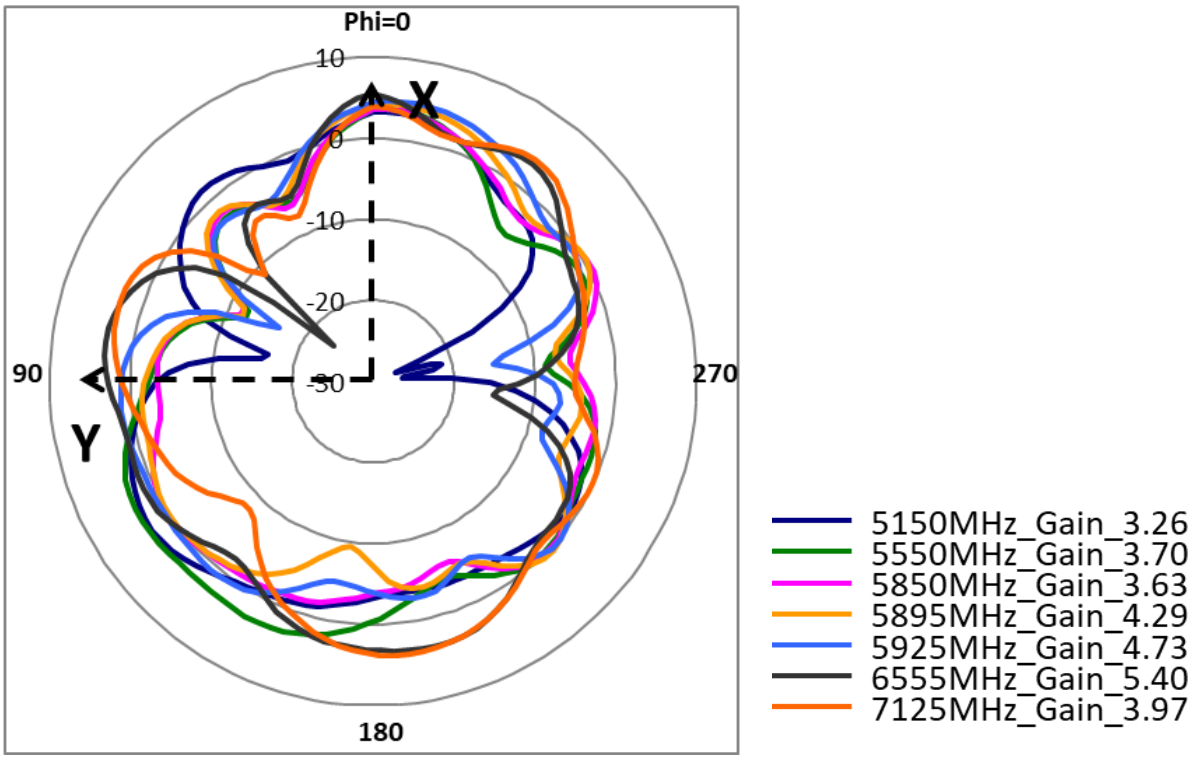
XY_Pol._Phi_Ant.4



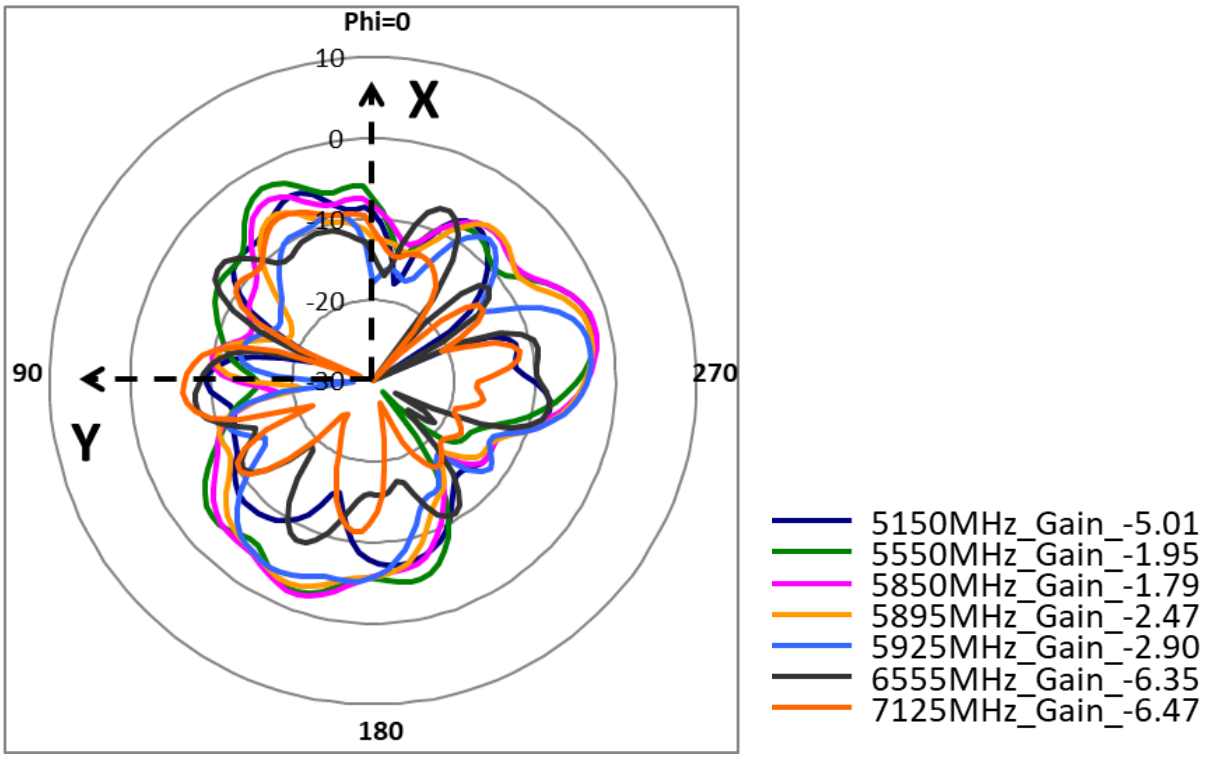
XY_Pol._Theta_Ant.1



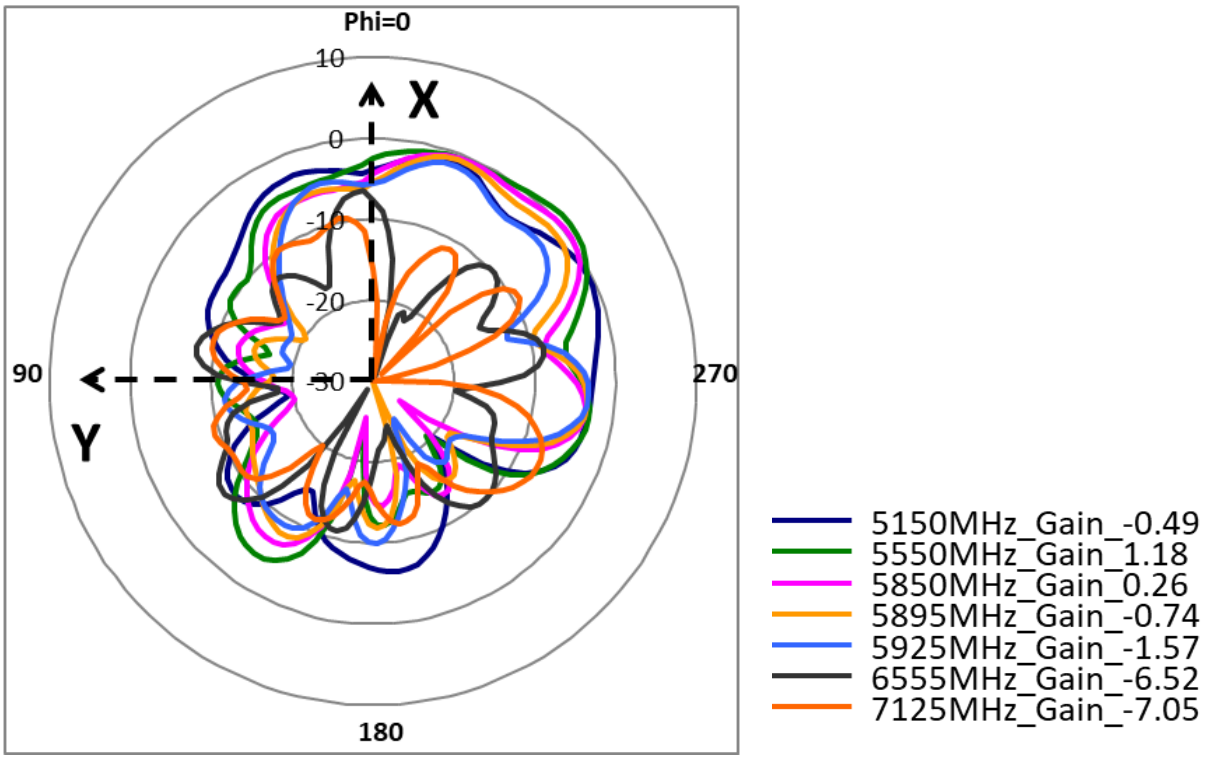
XY_Pol._Theta_Ant.2



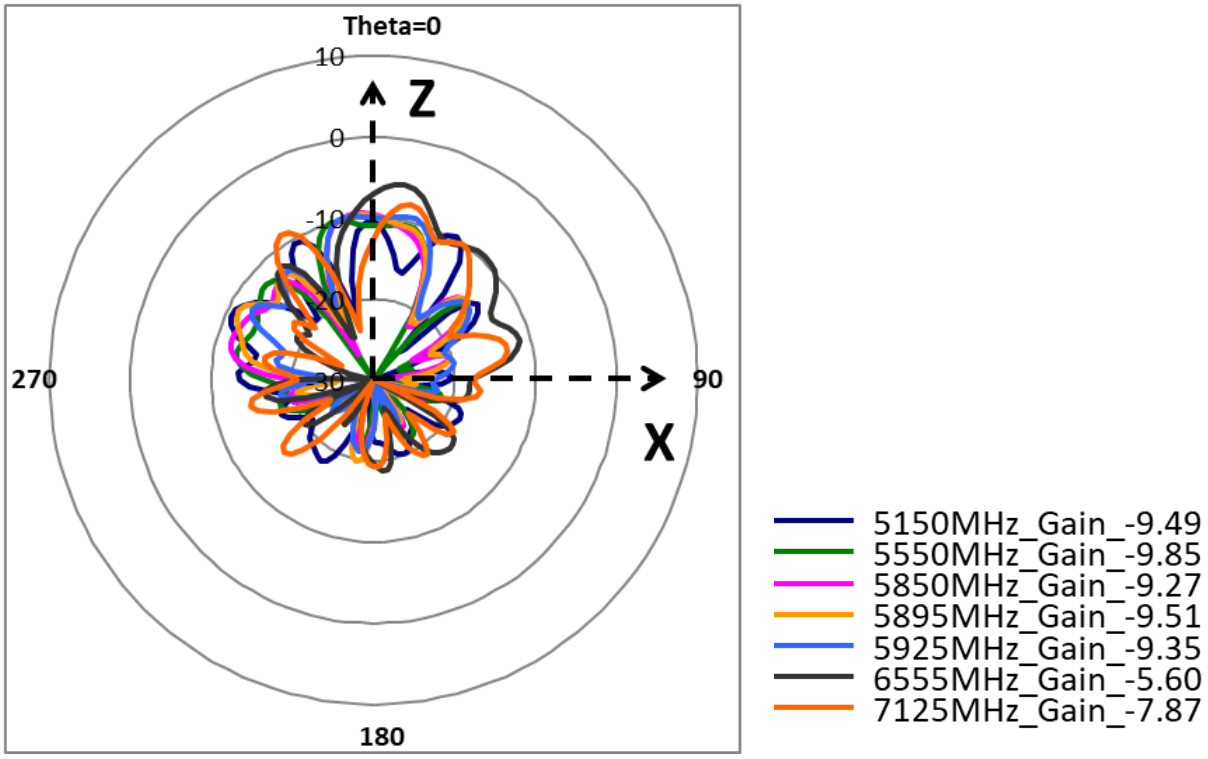
XY_Pol._Theta_Ant.3



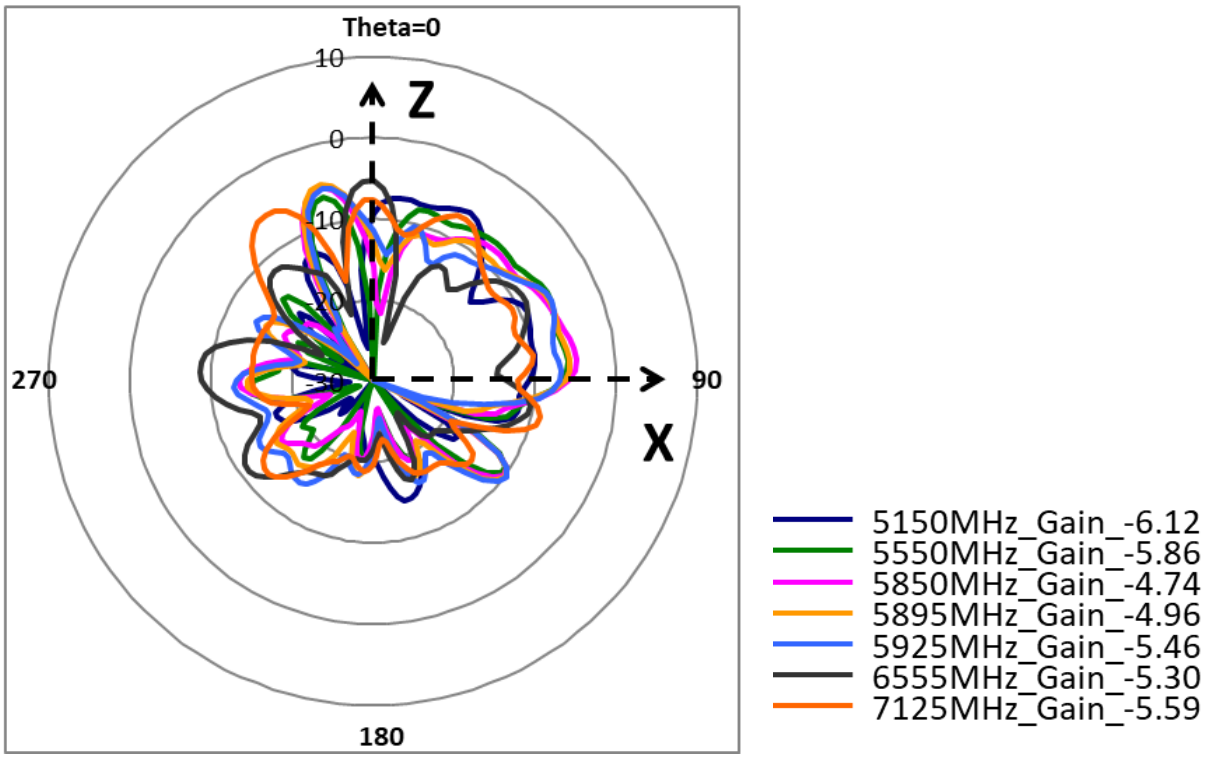
XY_Pol._Theta_Ant.4



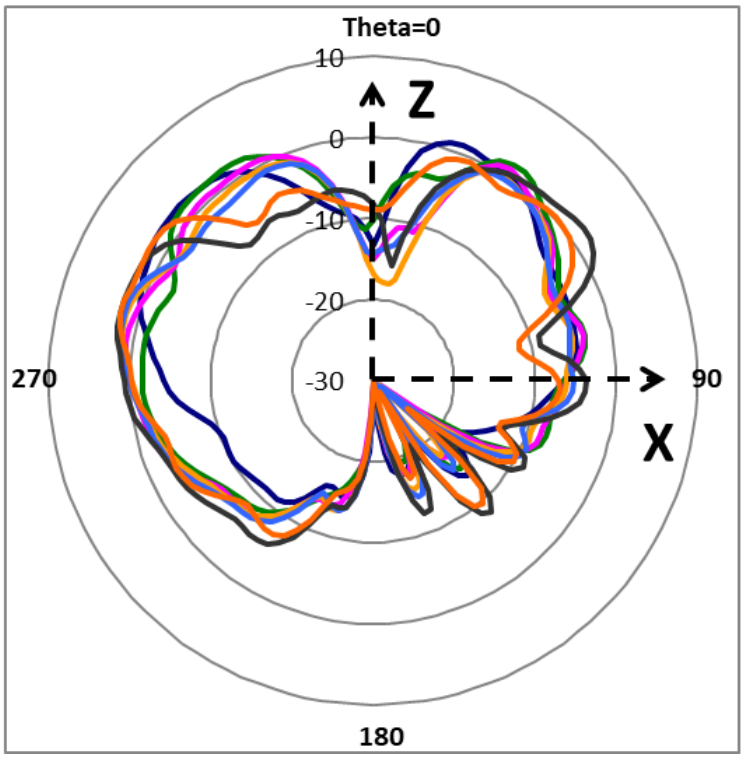
XZ_Pol._Phi_Ant.1



XZ_Pol._Phi_Ant.2

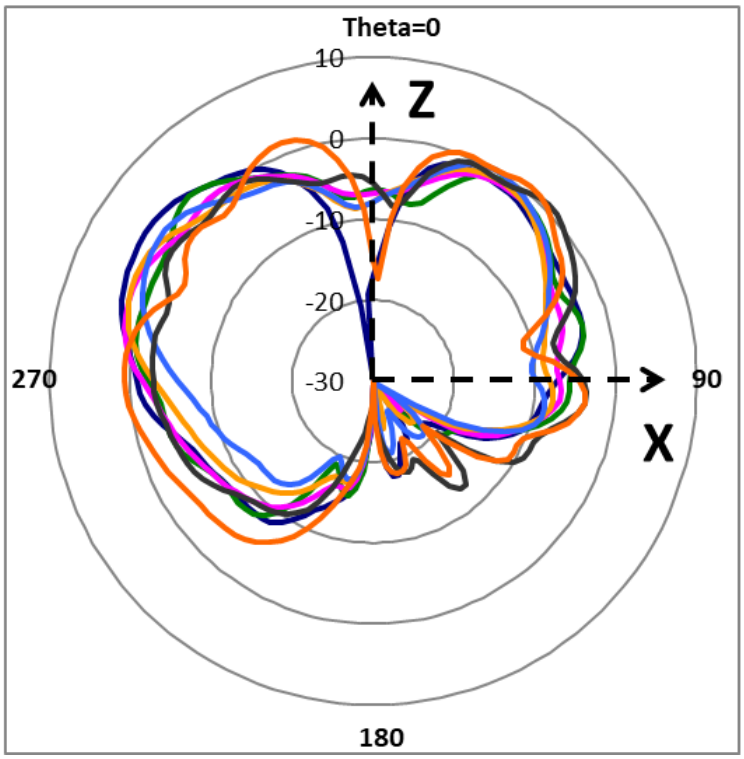


XZ_Pol._Phi_Ant.3



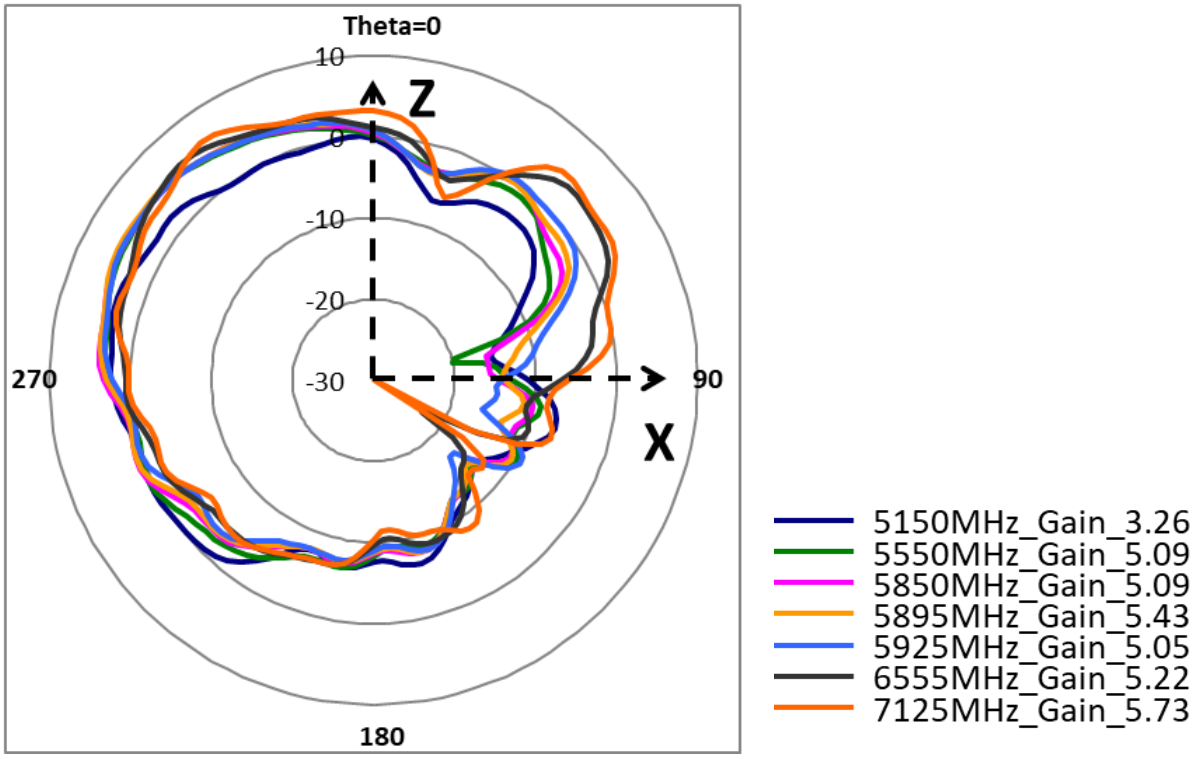
5150MHz_Gain_2.22
5550MHz_Gain_1.93
5850MHz_Gain_1.08
5895MHz_Gain_1.53
5925MHz_Gain_1.81
6555MHz_Gain_2.25
7125MHz_Gain_2.21

XZ_Pol._Phi_Ant.4

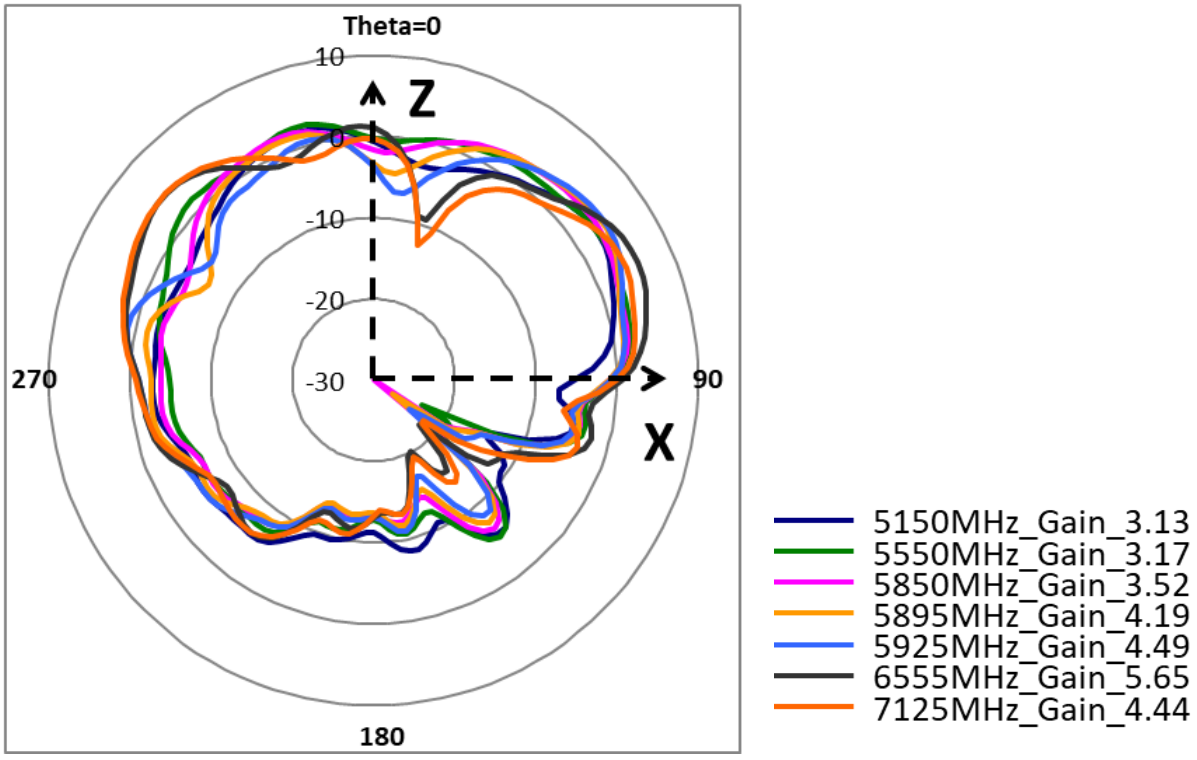


5150MHz_Gain_3.55
5550MHz_Gain_2.19
5850MHz_Gain_1.78
5895MHz_Gain_2.07
5925MHz_Gain_1.74
6555MHz_Gain_0.77
7125MHz_Gain_1.46

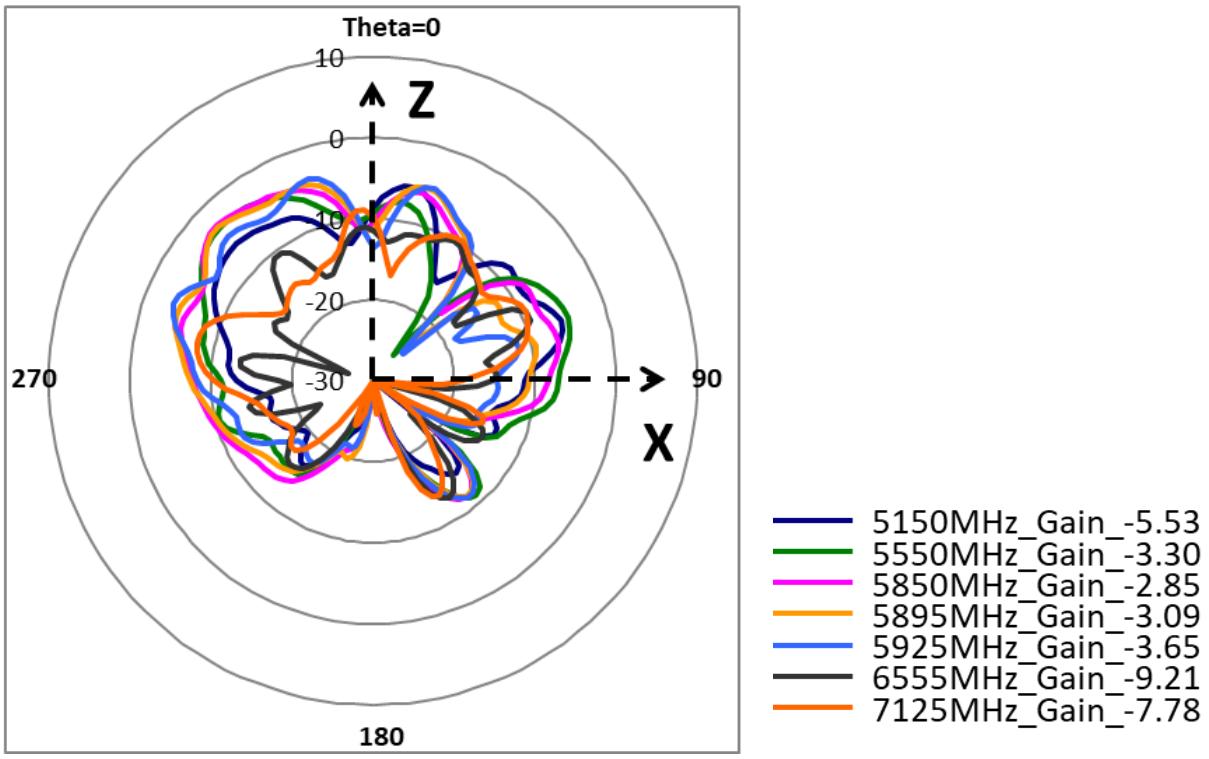
XZ_Pol._Theta_Ant.1



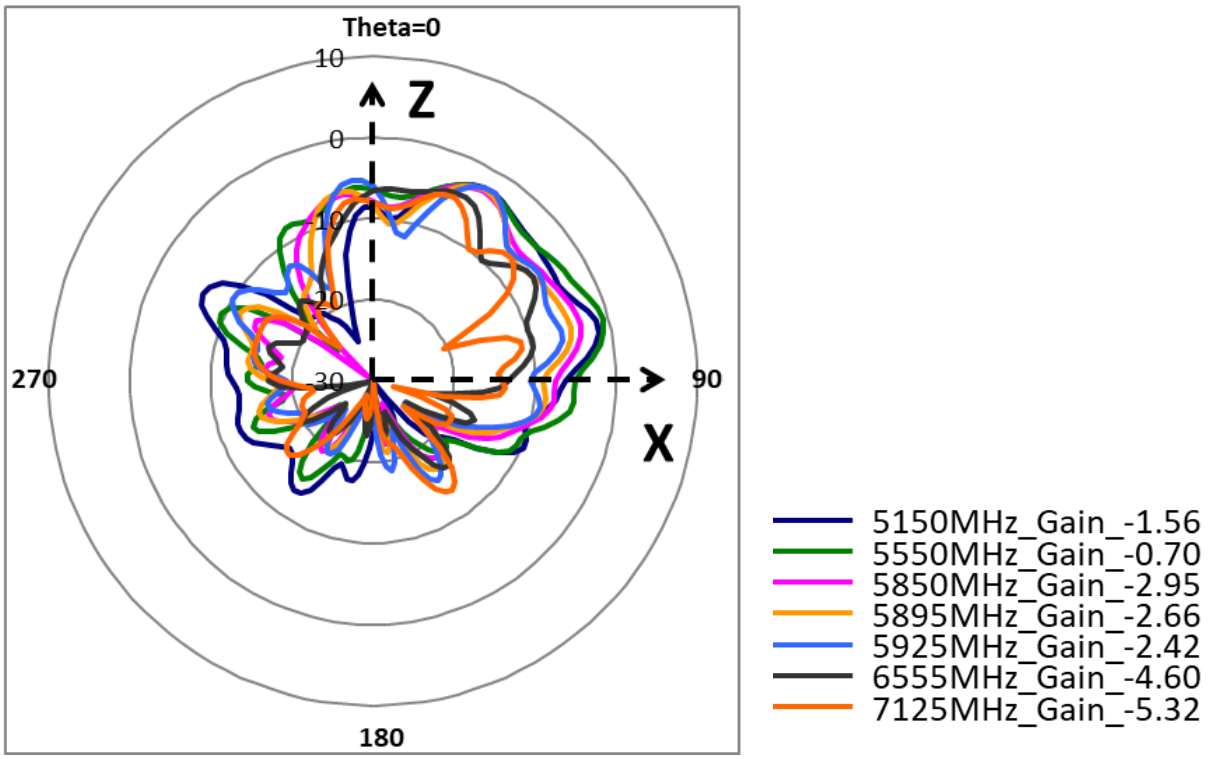
XZ_Pol._Theta_Ant.2



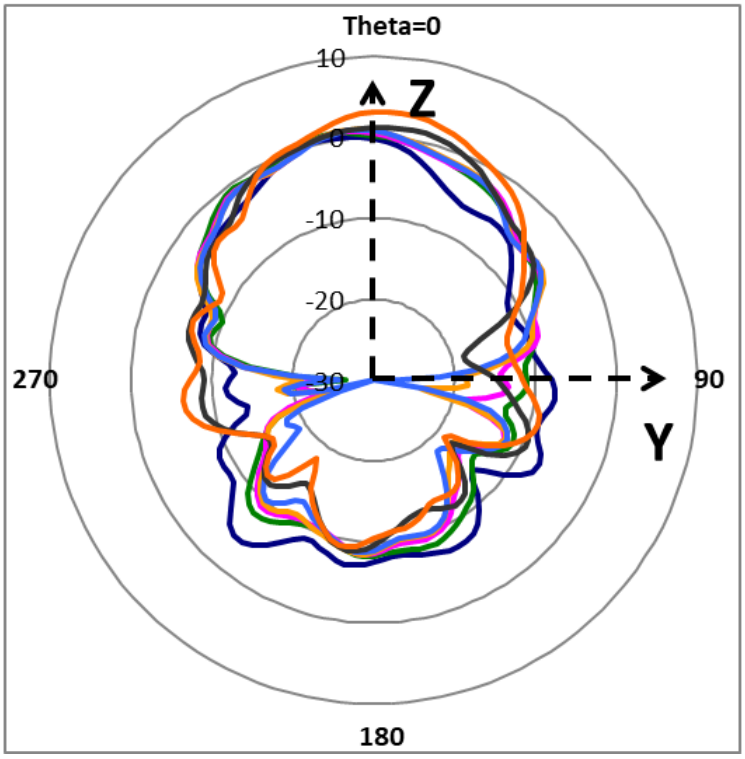
XZ_Pol._Theta_Ant.3



XZ_Pol._Theta_Ant.4

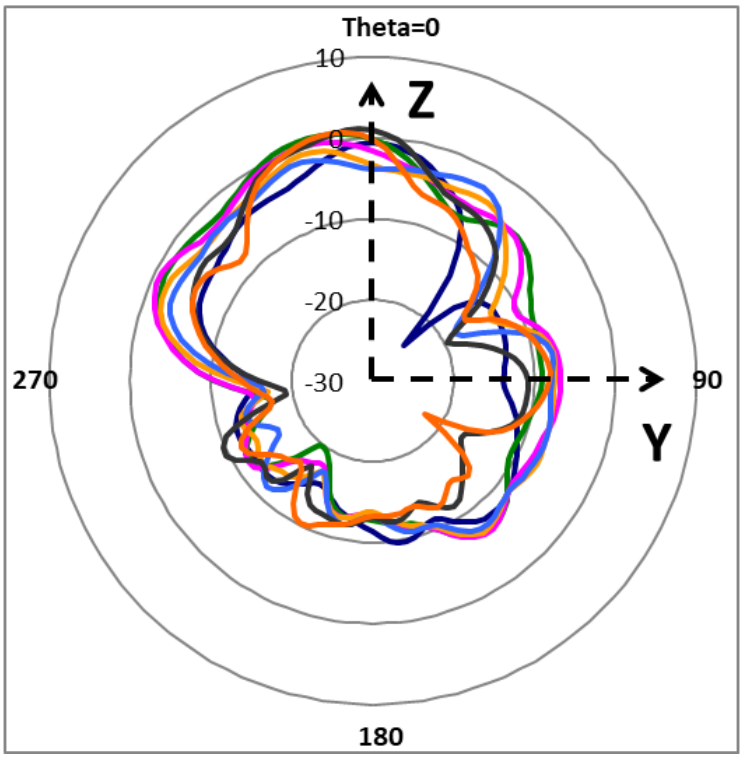


YZ_Pol._Phi_Ant.1



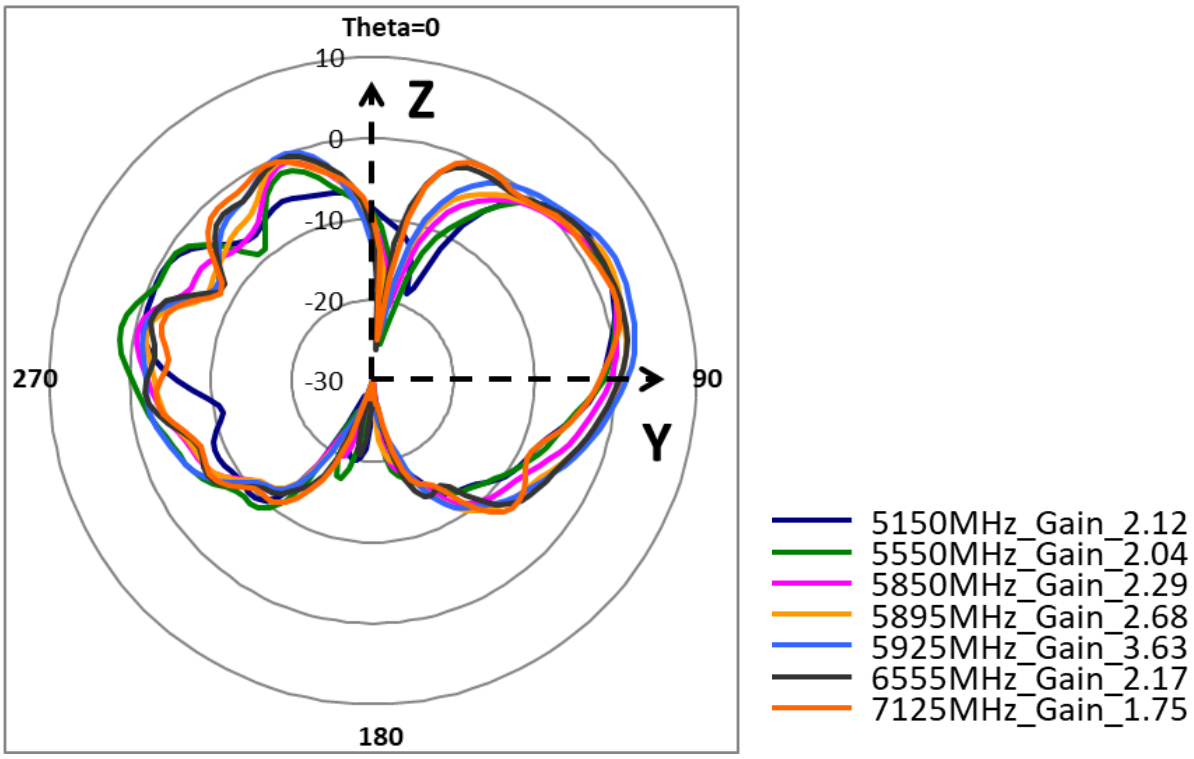
5150MHz_Gain_0.36
5550MHz_Gain_0.93
5850MHz_Gain_0.96
5895MHz_Gain_1.10
5925MHz_Gain_0.99
6555MHz_Gain_1.29
7125MHz_Gain_2.76

YZ_Pol._Phi_Ant.2

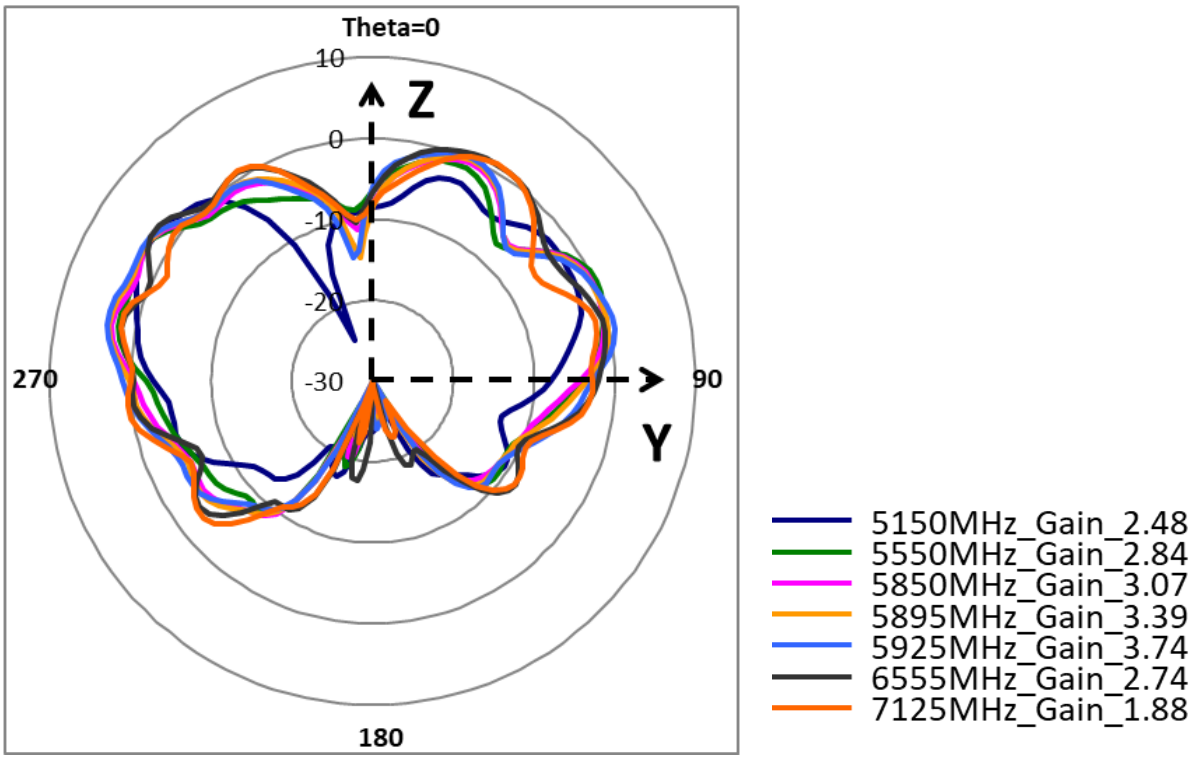


5150MHz_Gain_-0.57
5550MHz_Gain_1.02
5850MHz_Gain_0.26
5895MHz_Gain_-0.71
5925MHz_Gain_-1.63
6555MHz_Gain_1.22
7125MHz_Gain_1.04

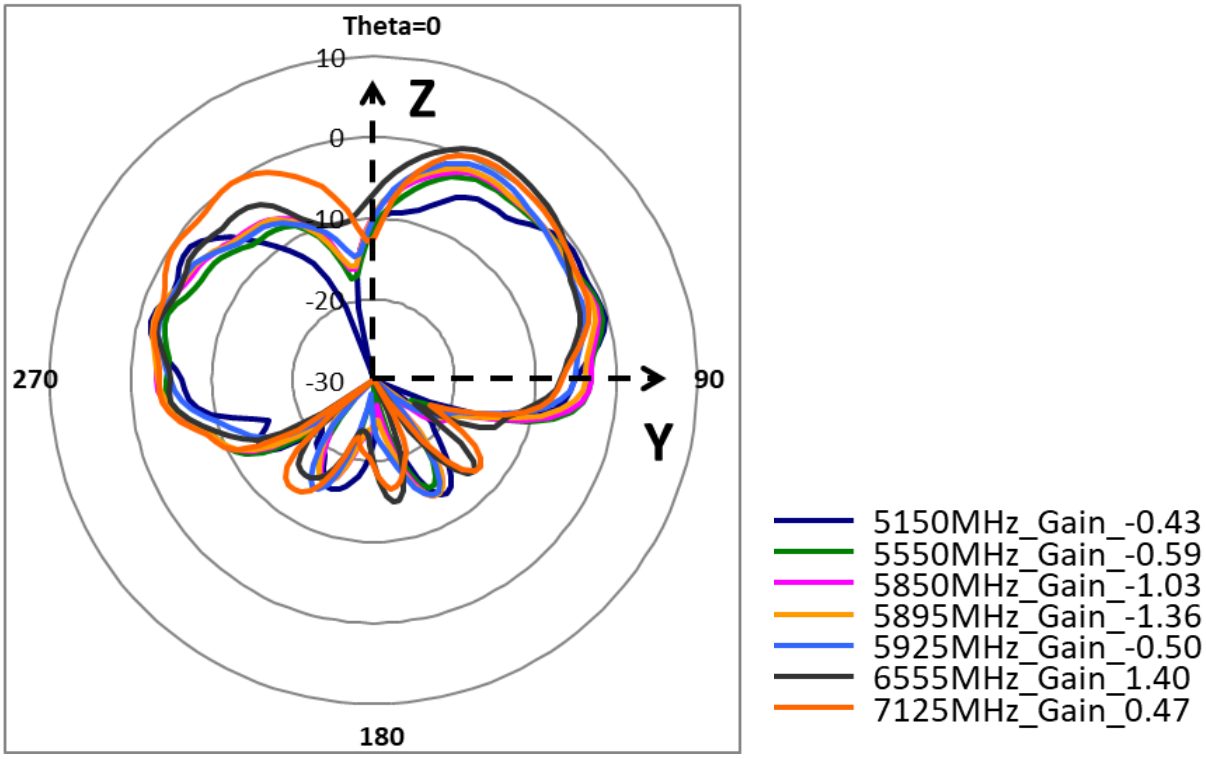
YZ_Pol._Phi_Ant.3



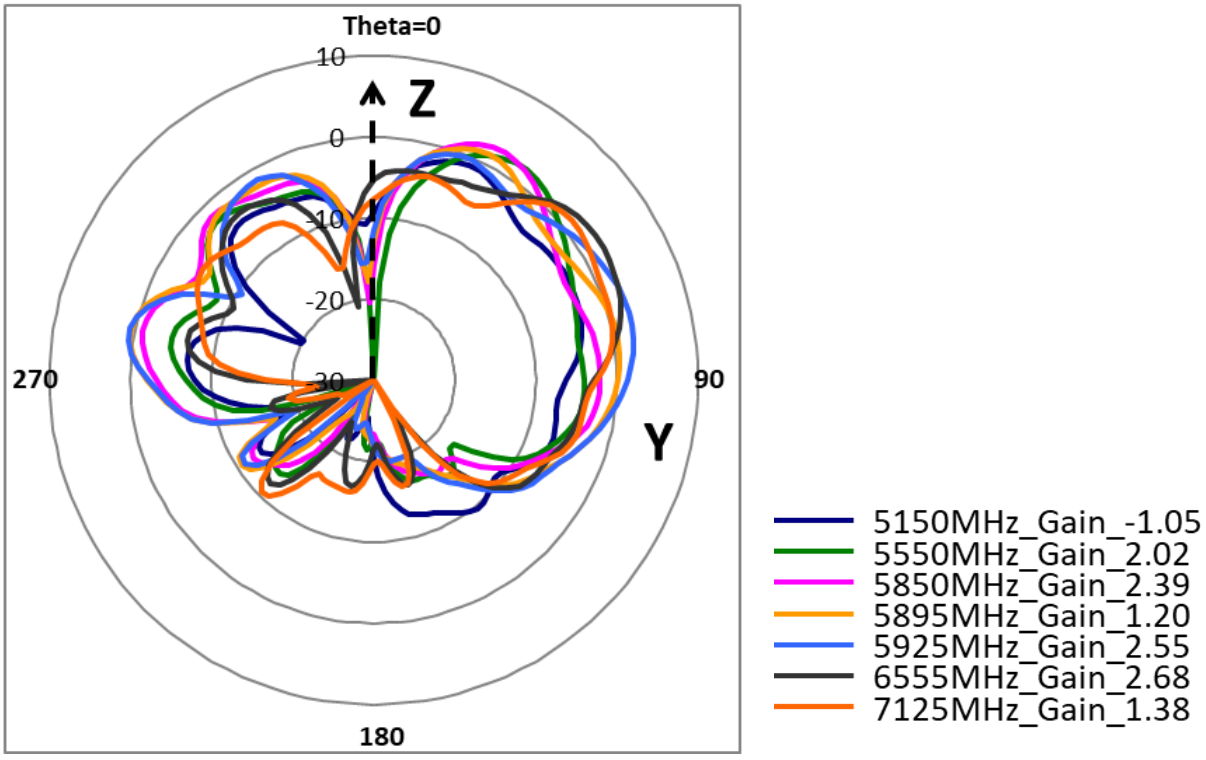
YZ_Pol._Phi_Ant.4



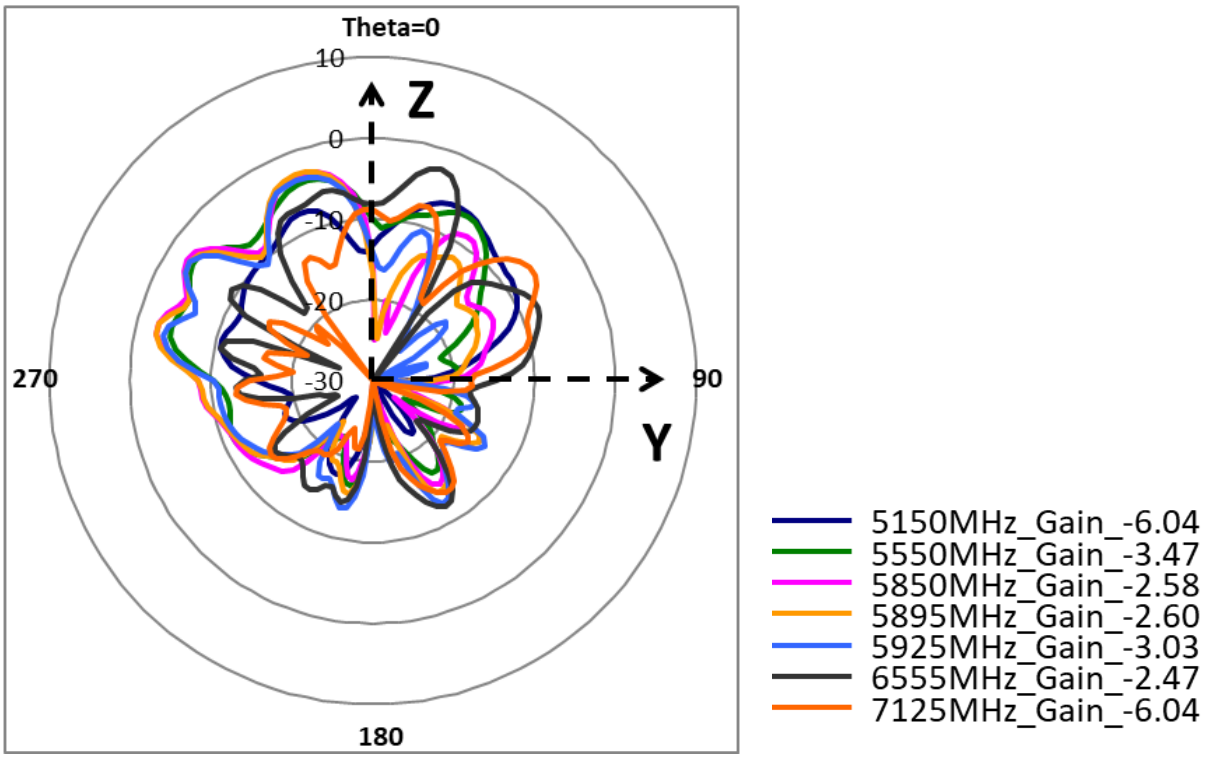
YZ_Pol._Theta_Ant.1



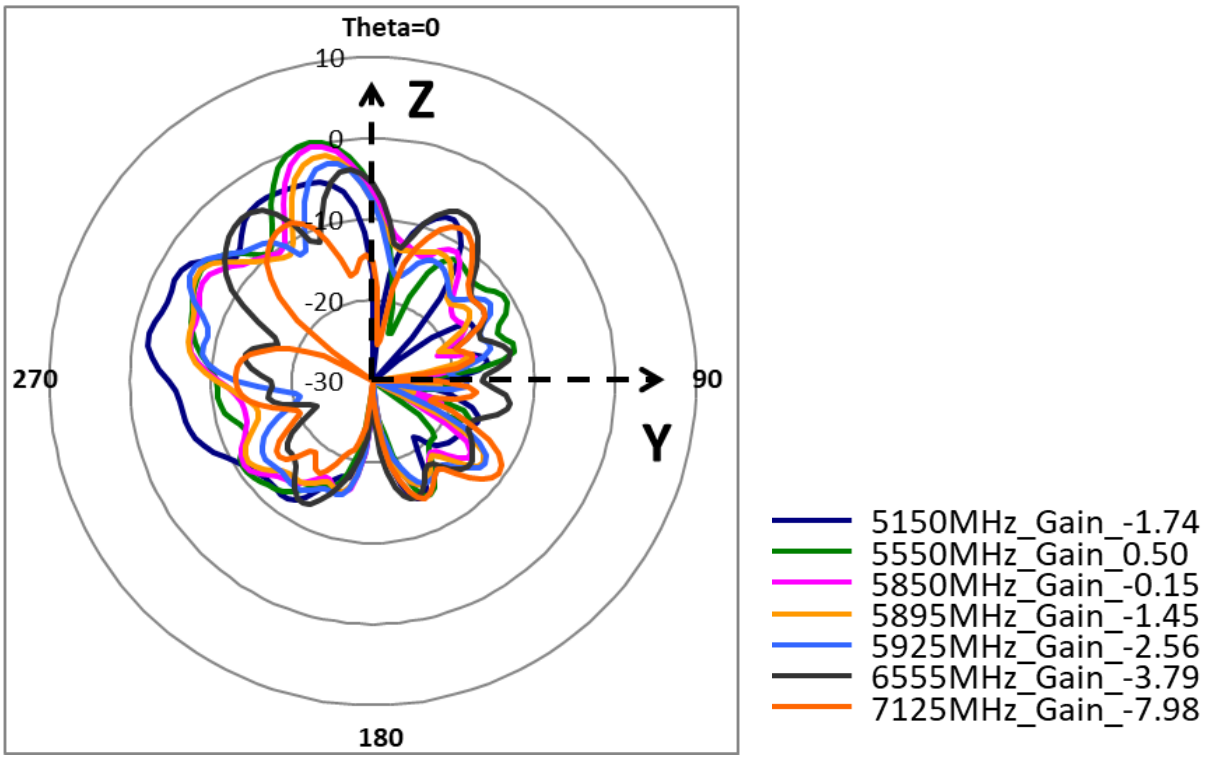
YZ_Pol._Theta_Ant.2



YZ_Pol._Theta_Ant.3

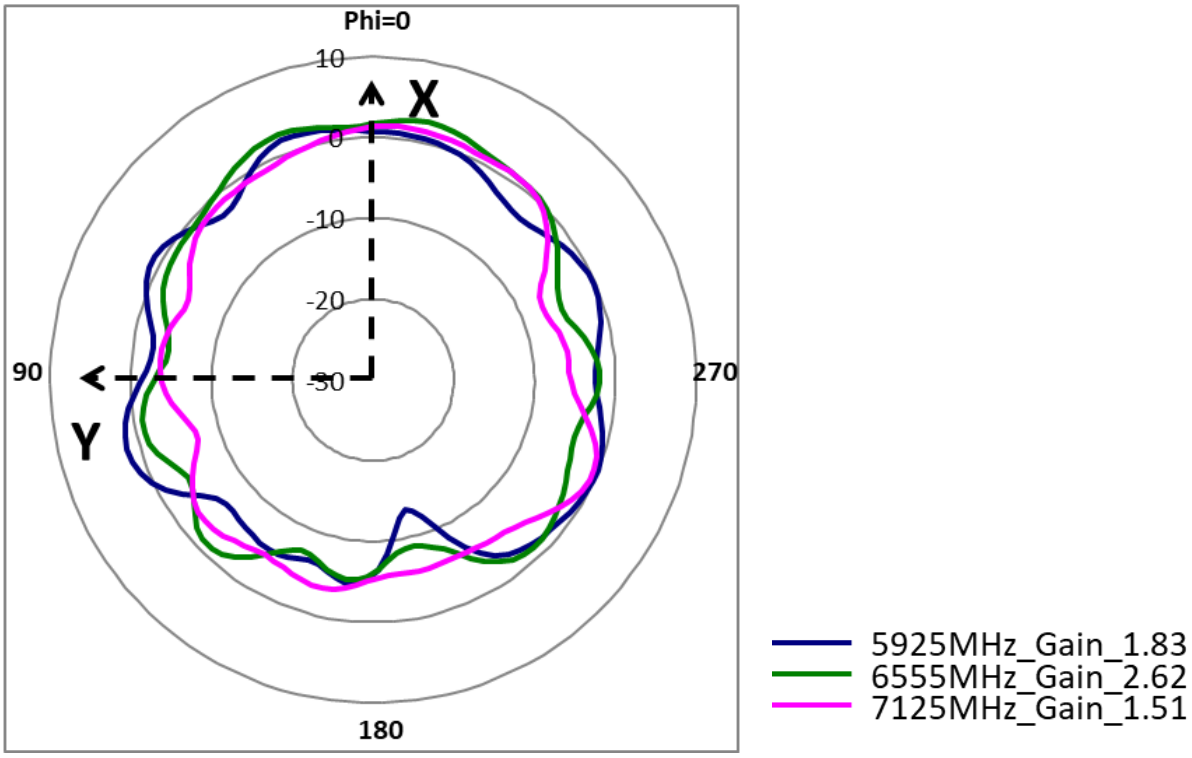


YZ_Pol._Theta_Ant.4

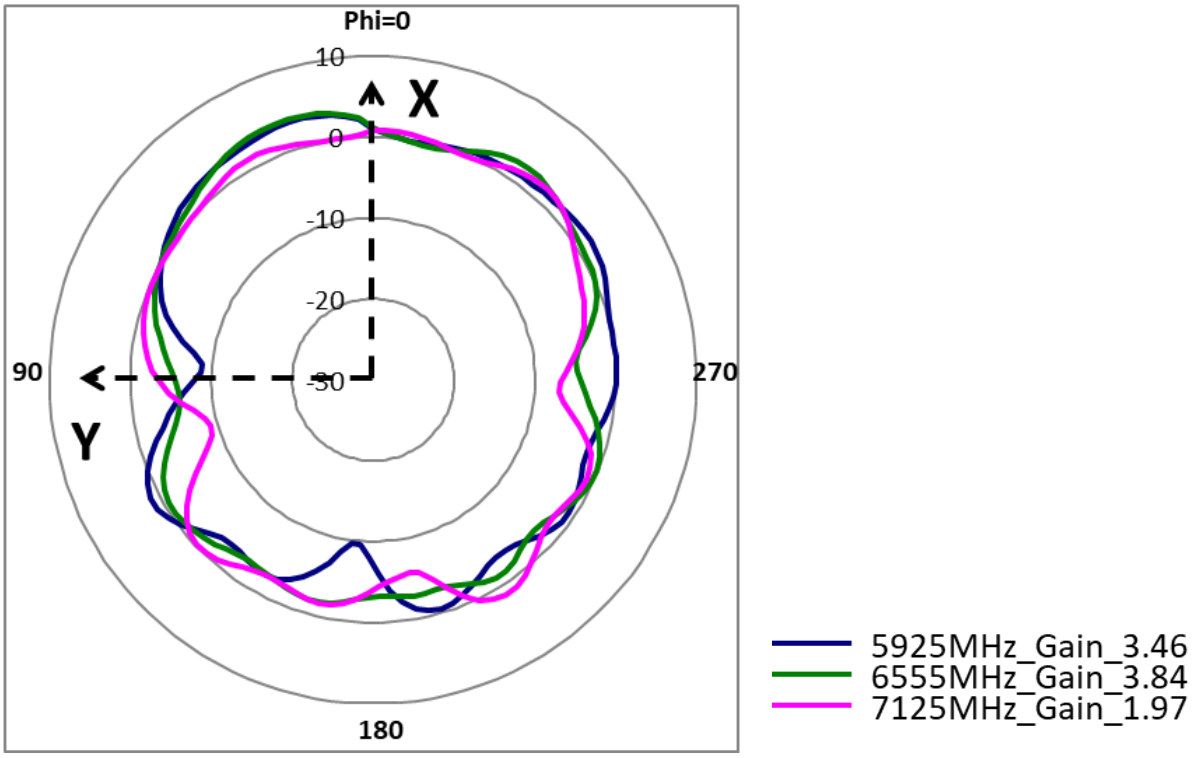


Ant. Position：6G Ant.5~8

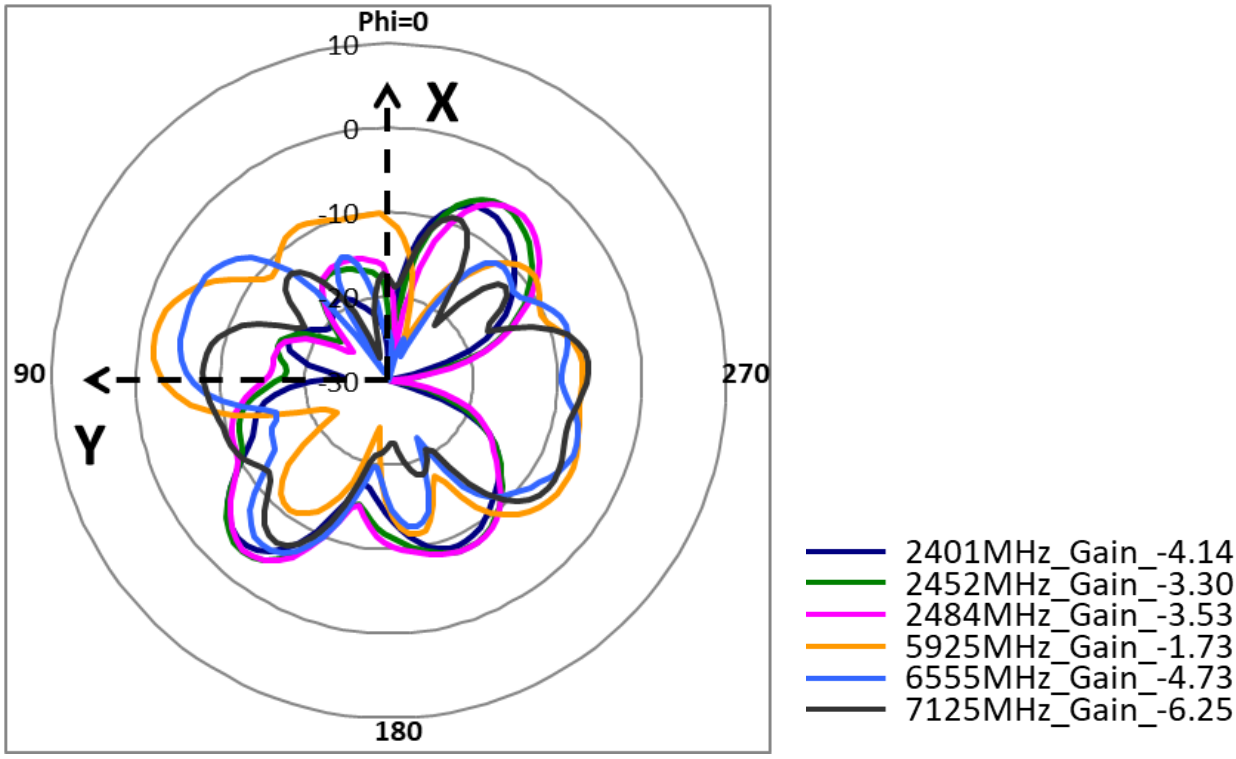
XY_Pol._Phi_Ant.5



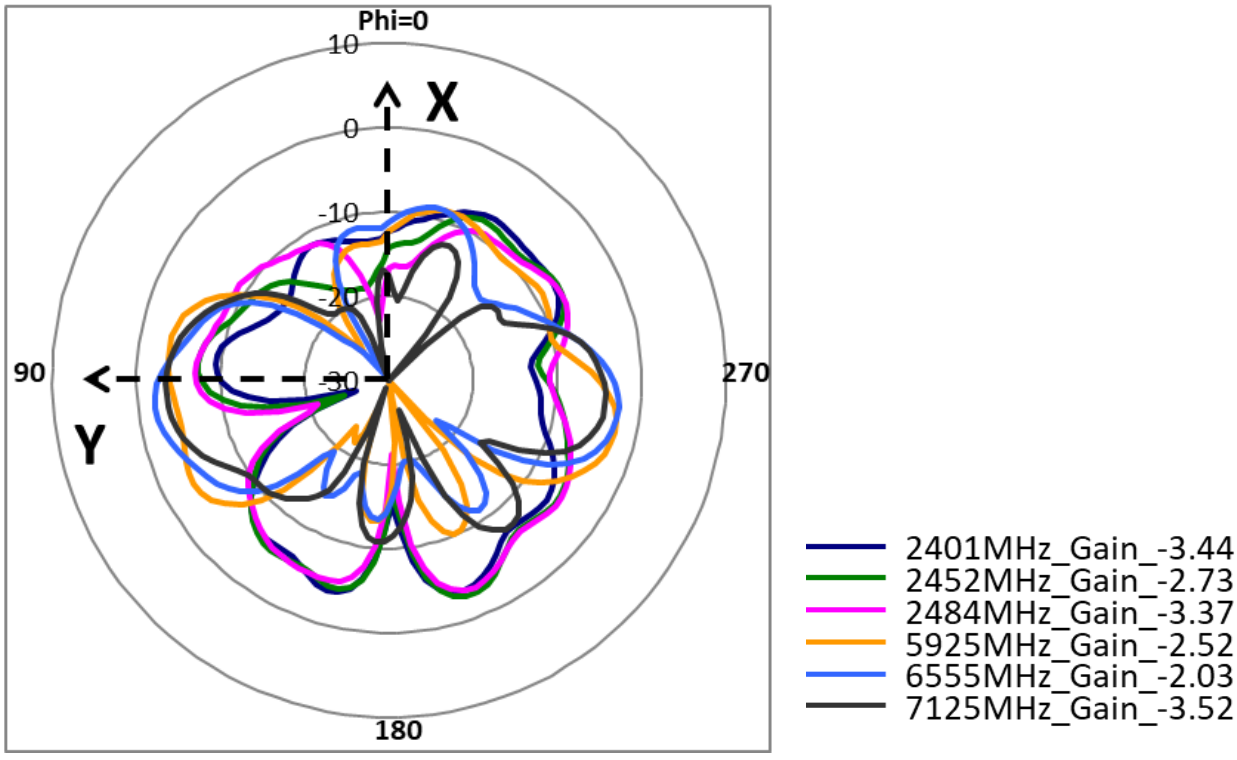
XY_Pol._Phi_Ant.6



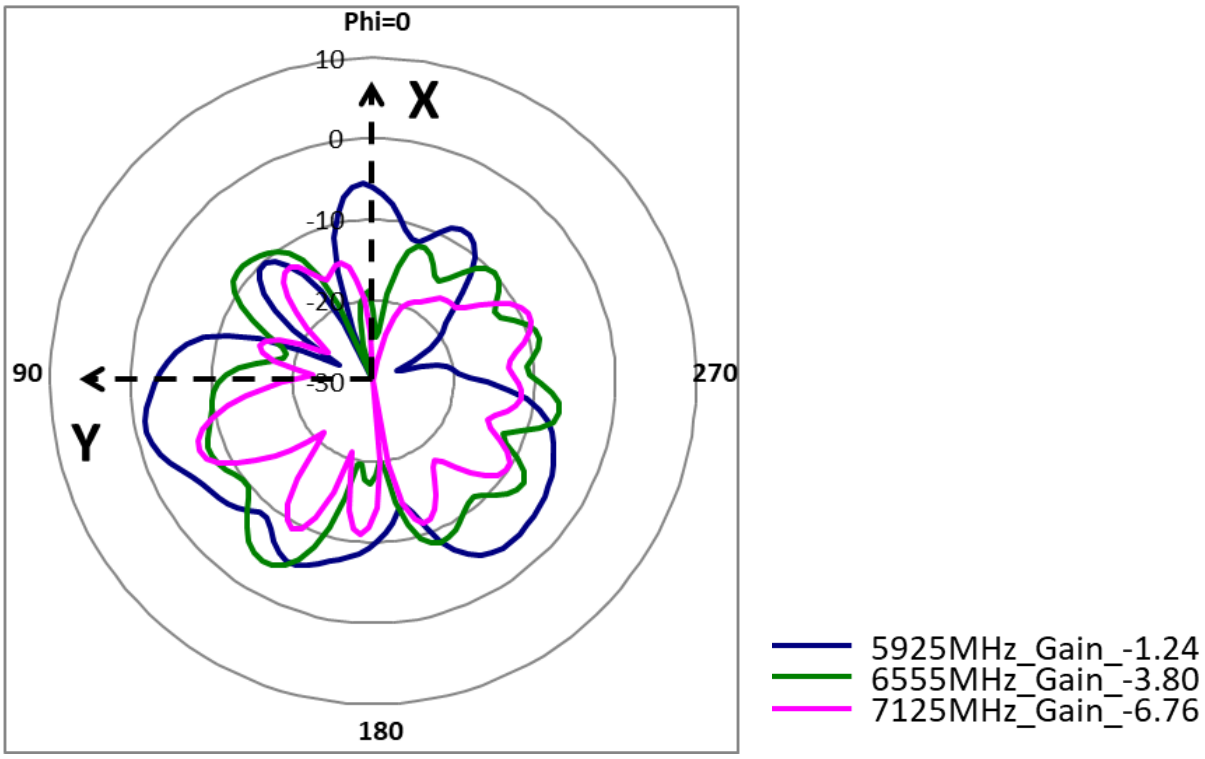
XY_Pol._Phi_Ant.7



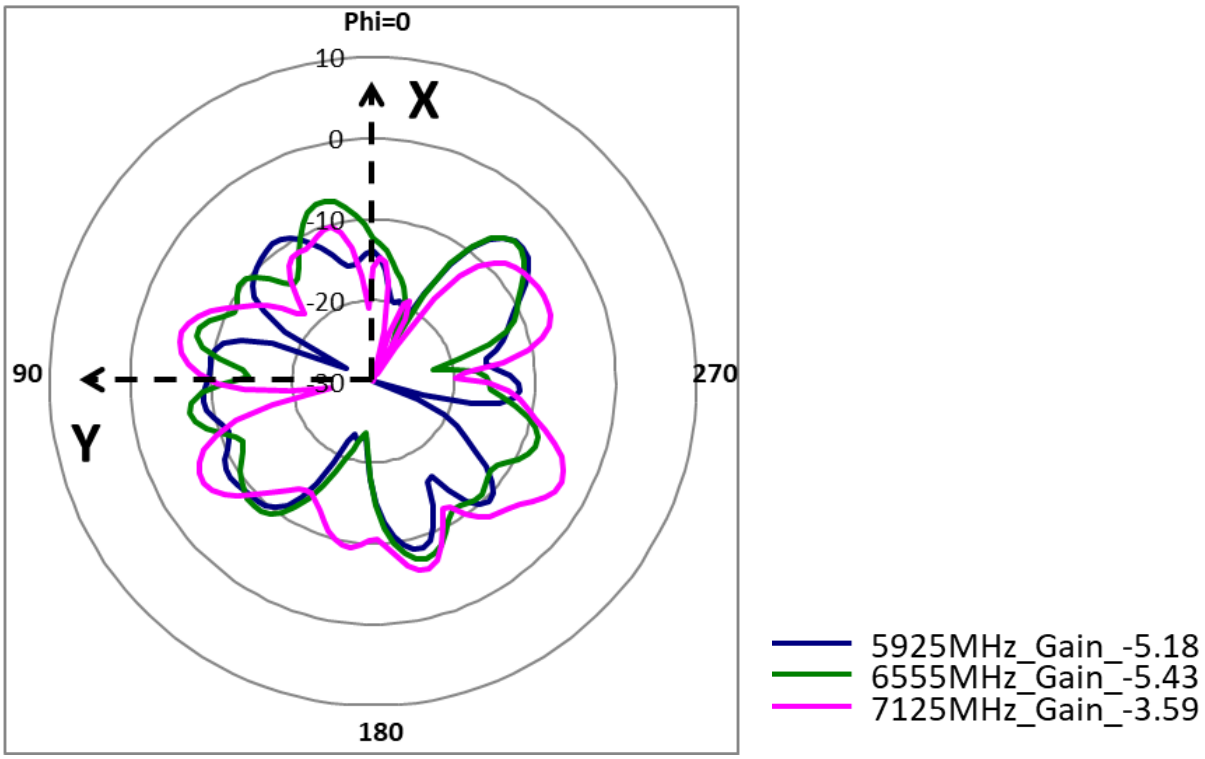
XY_Pol._Phi_Ant.8



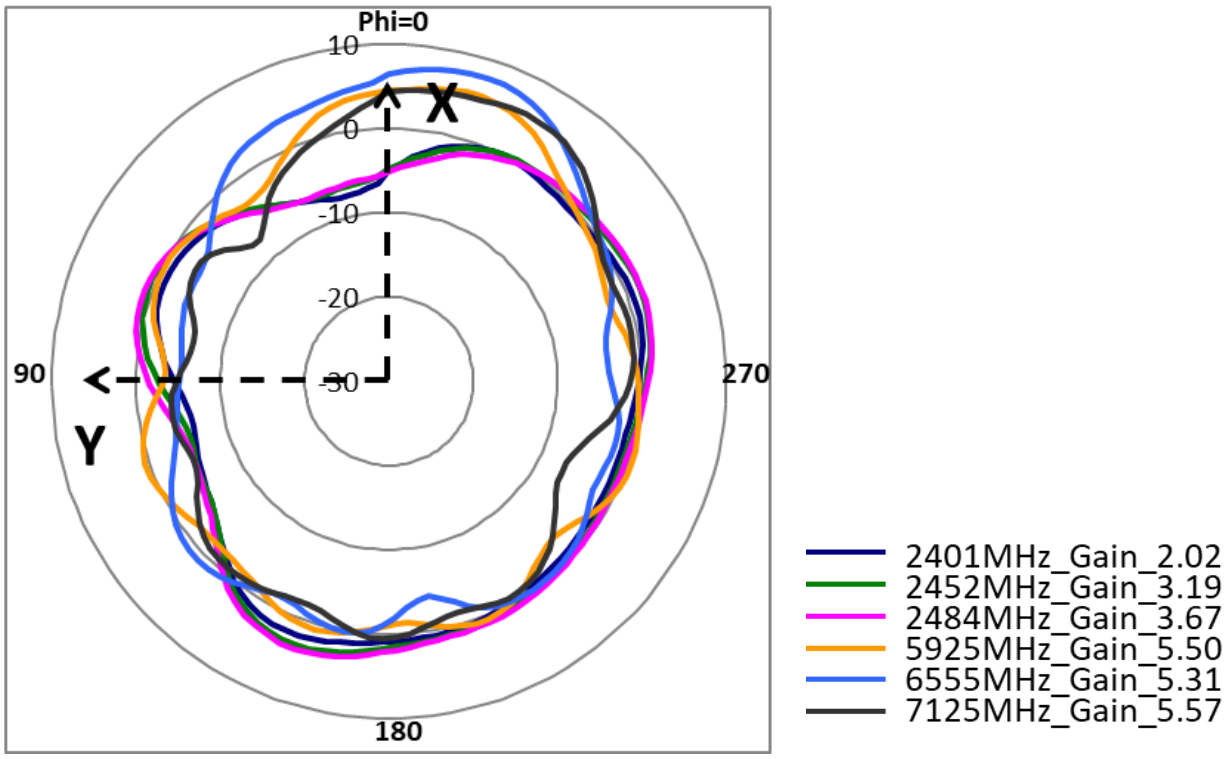
XY_Pol._Theta_Ant.5



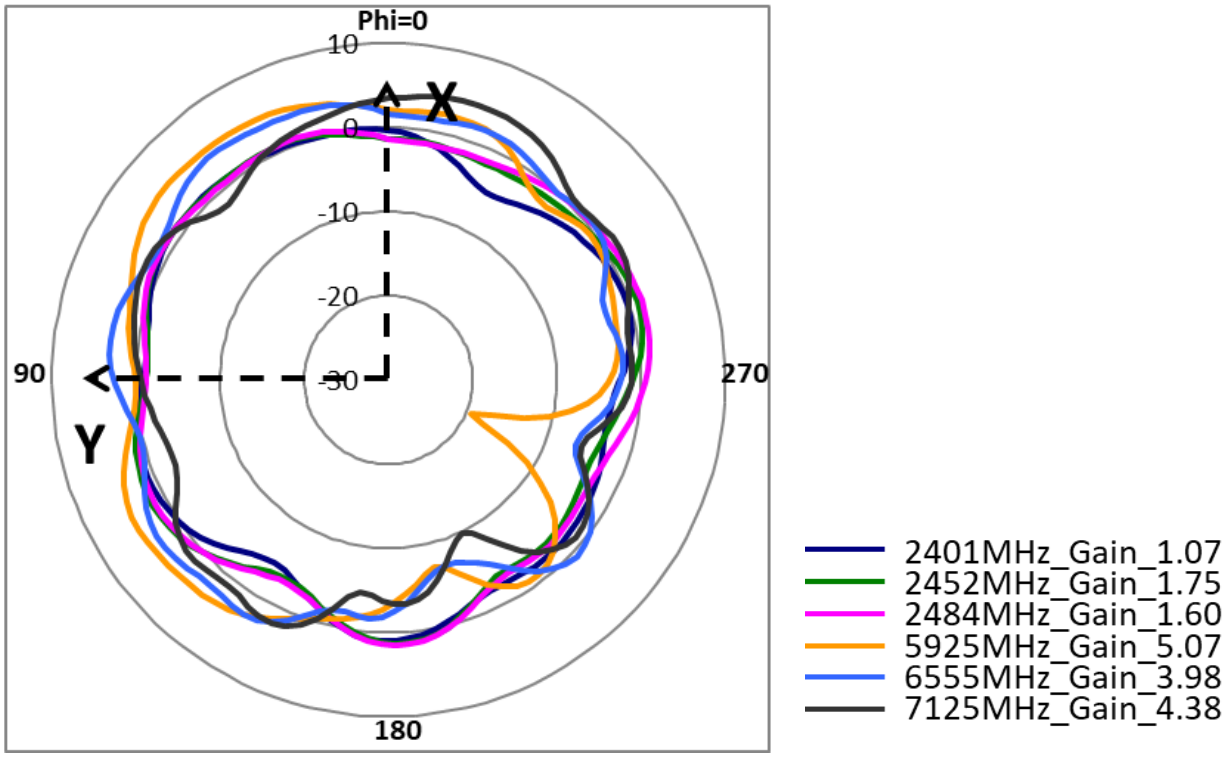
XY_Pol._Theta_Ant.6



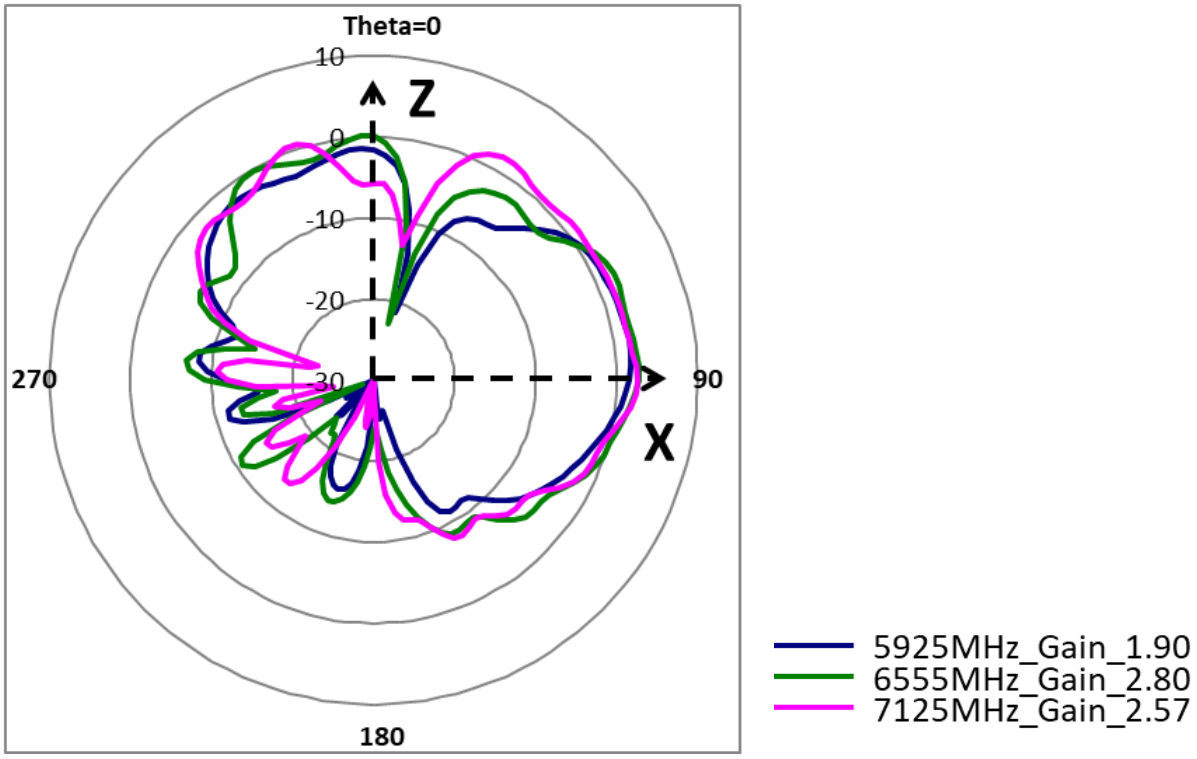
XY_Pol._Theta_Ant.7



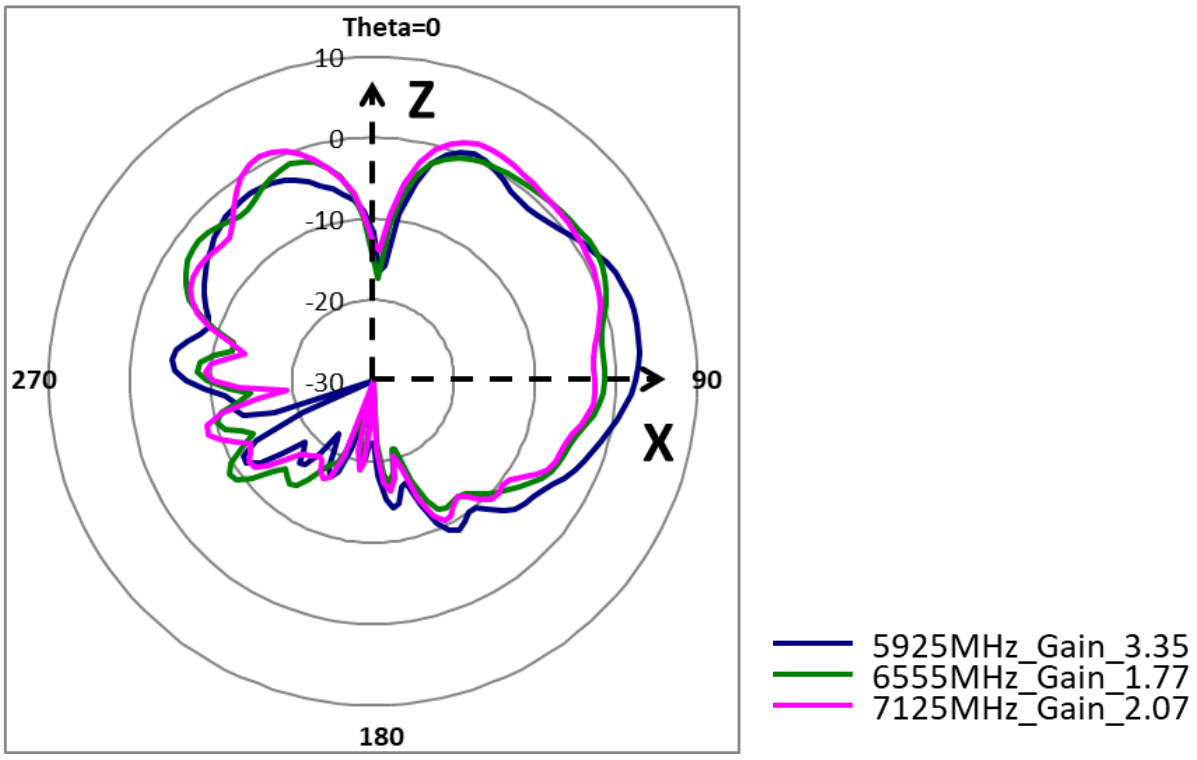
XY_Pol._Theta_Ant.8



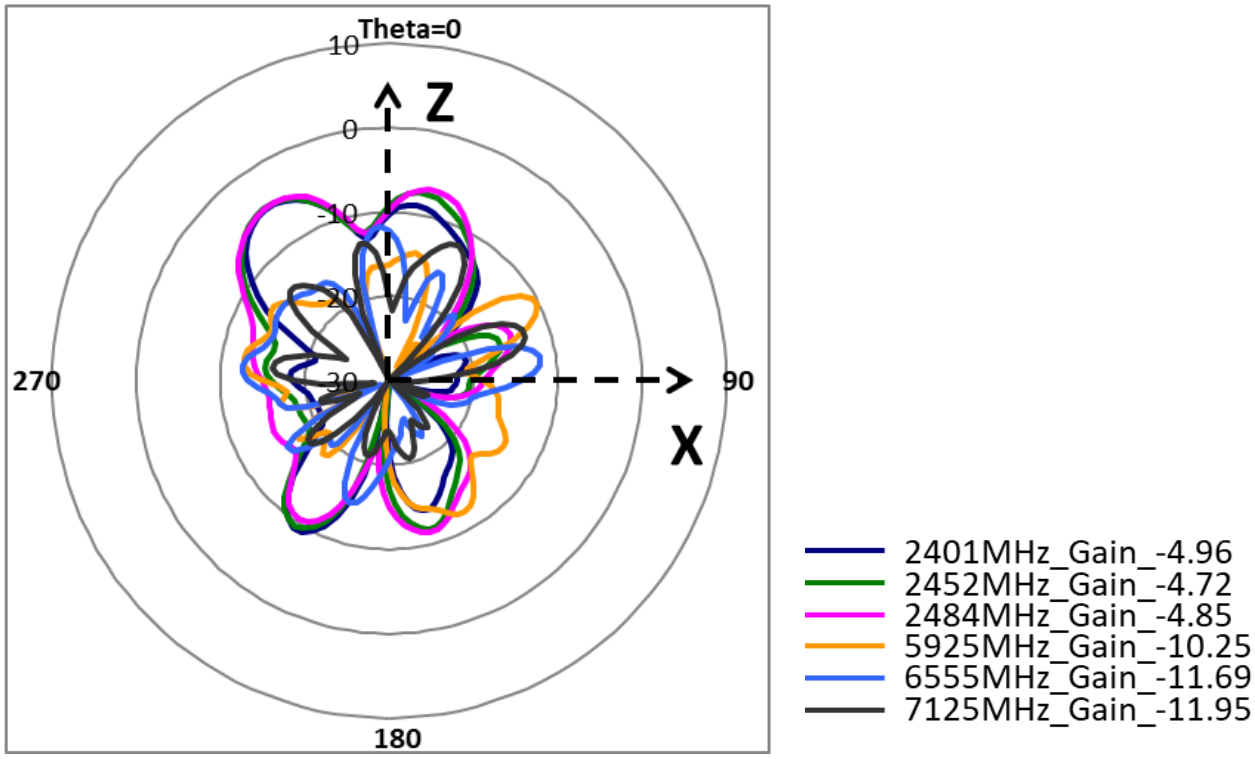
XZ_Pol._Phi_Ant.5



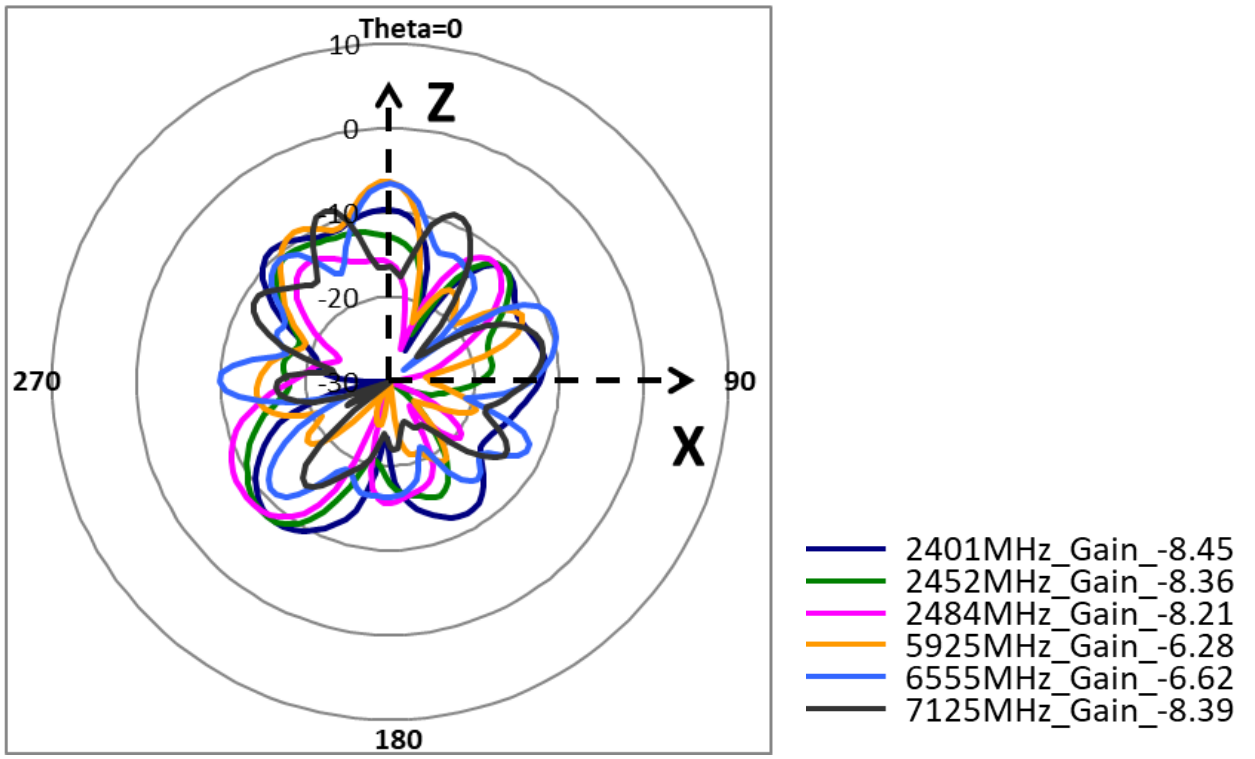
XZ_Pol._Phi_Ant.6



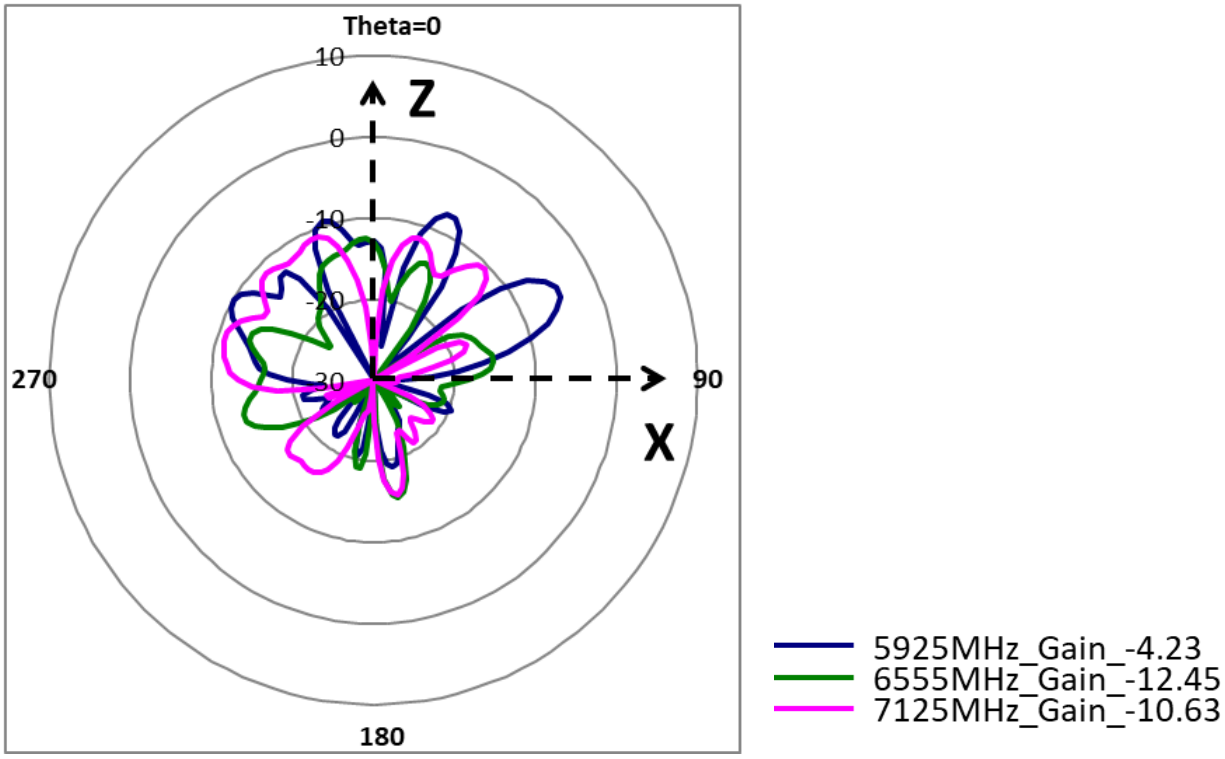
XZ_Pol._Phi_Ant.7



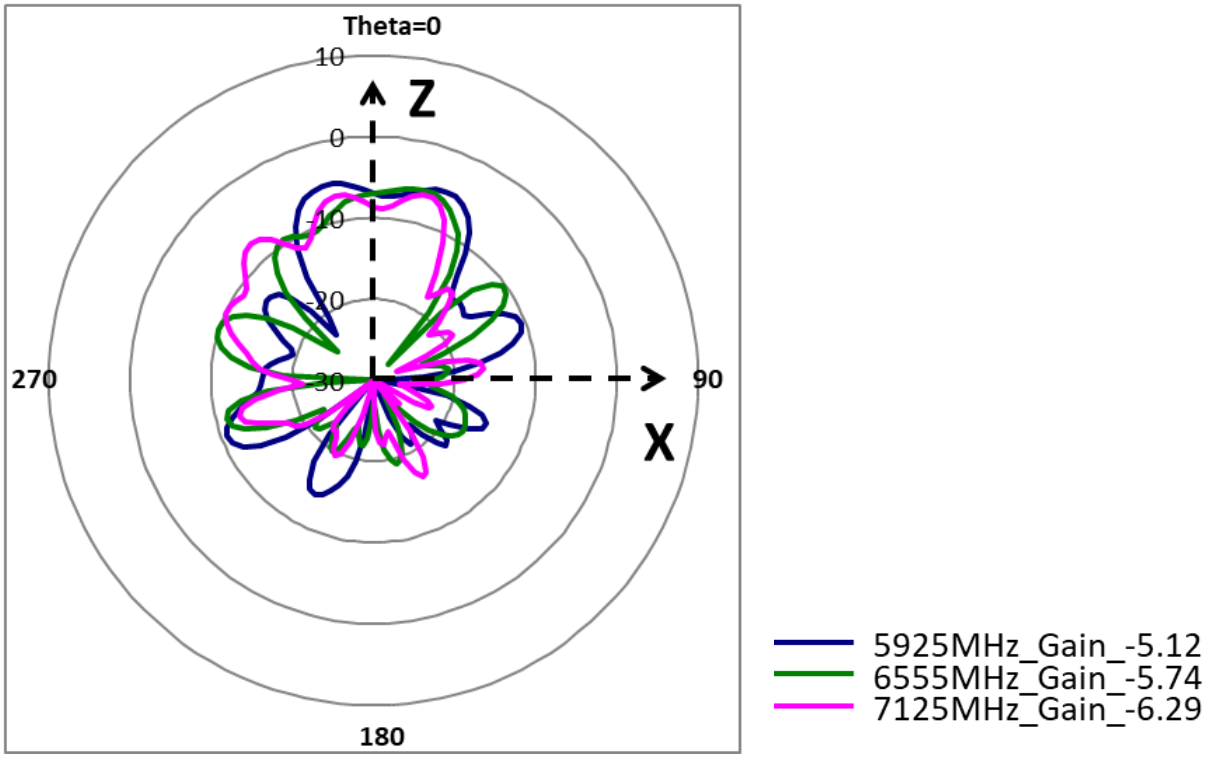
XZ_Pol._Phi_Ant.8



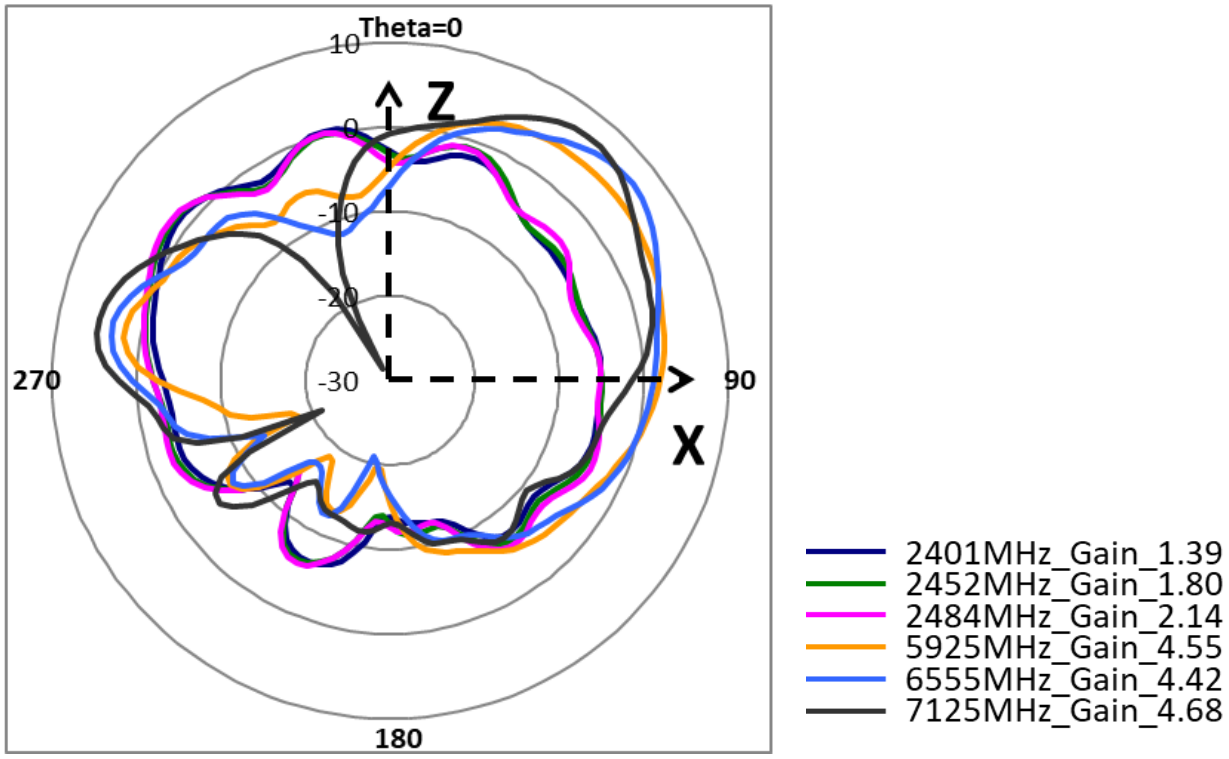
XZ_Pol._Theta_Ant.5



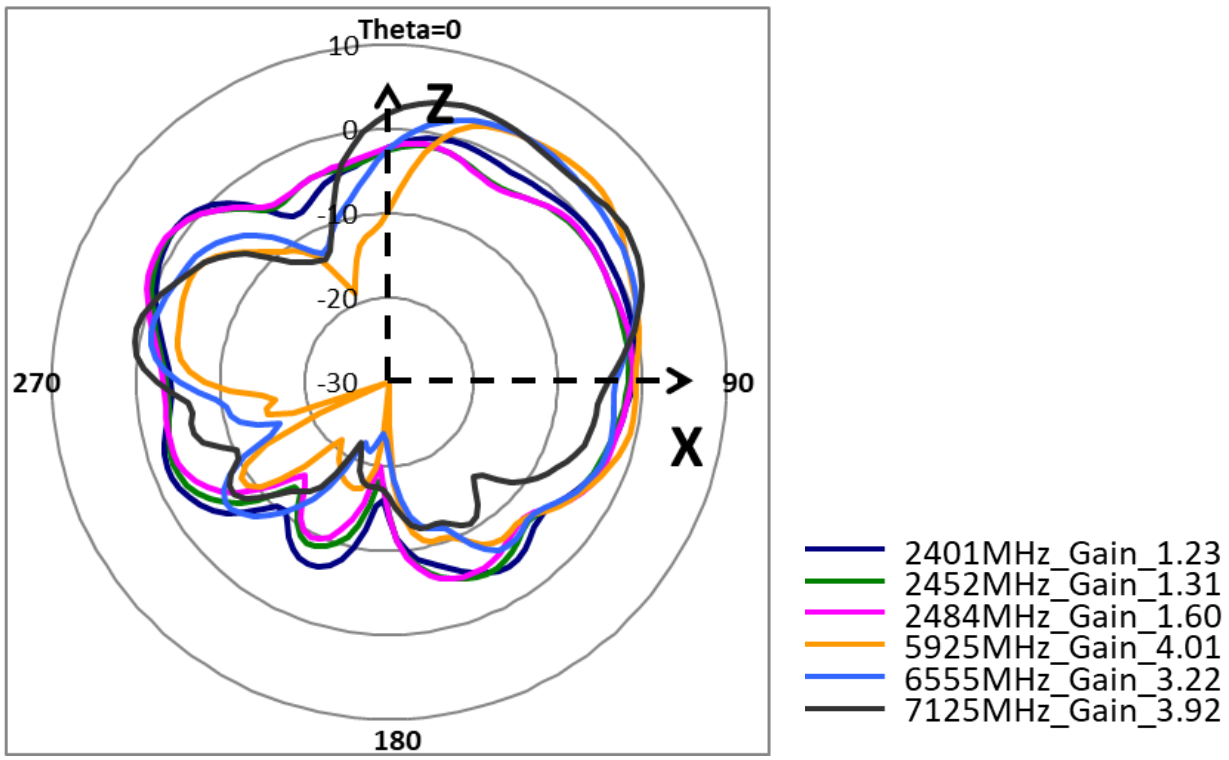
XZ_Pol._Theta_Ant.6



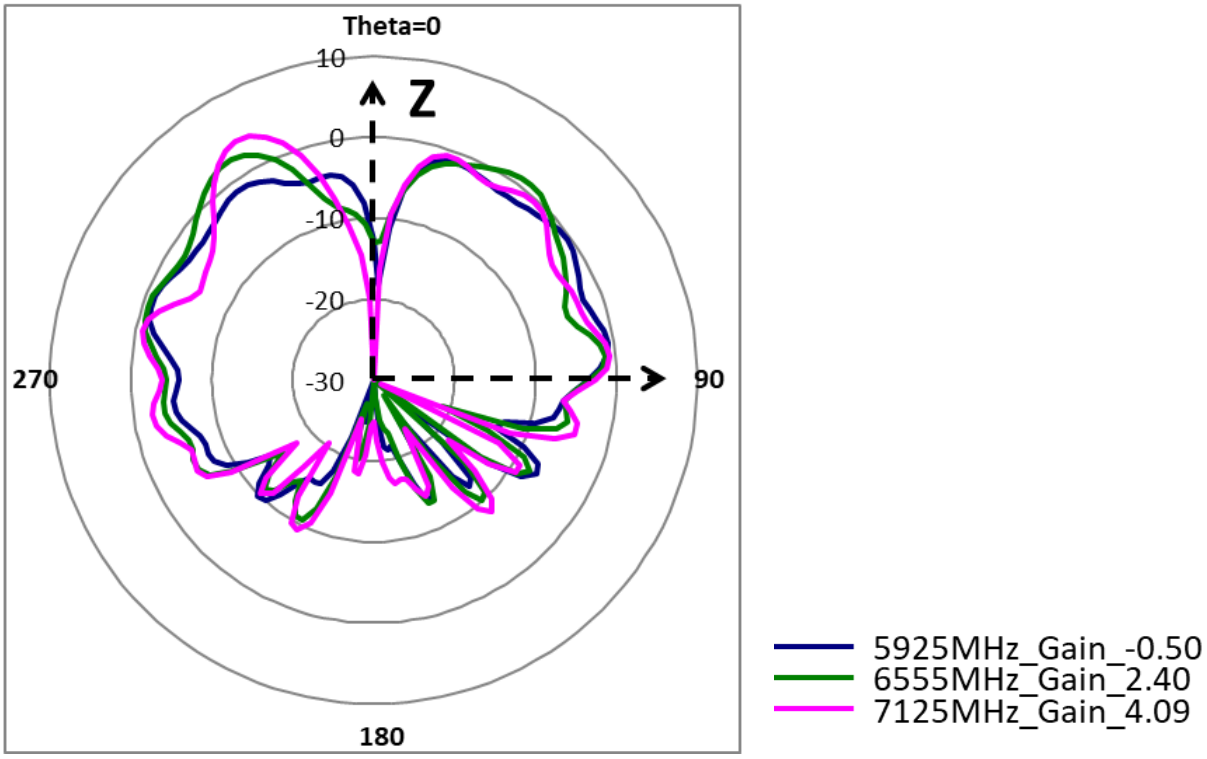
XZ_Pol._Theta_Ant.7



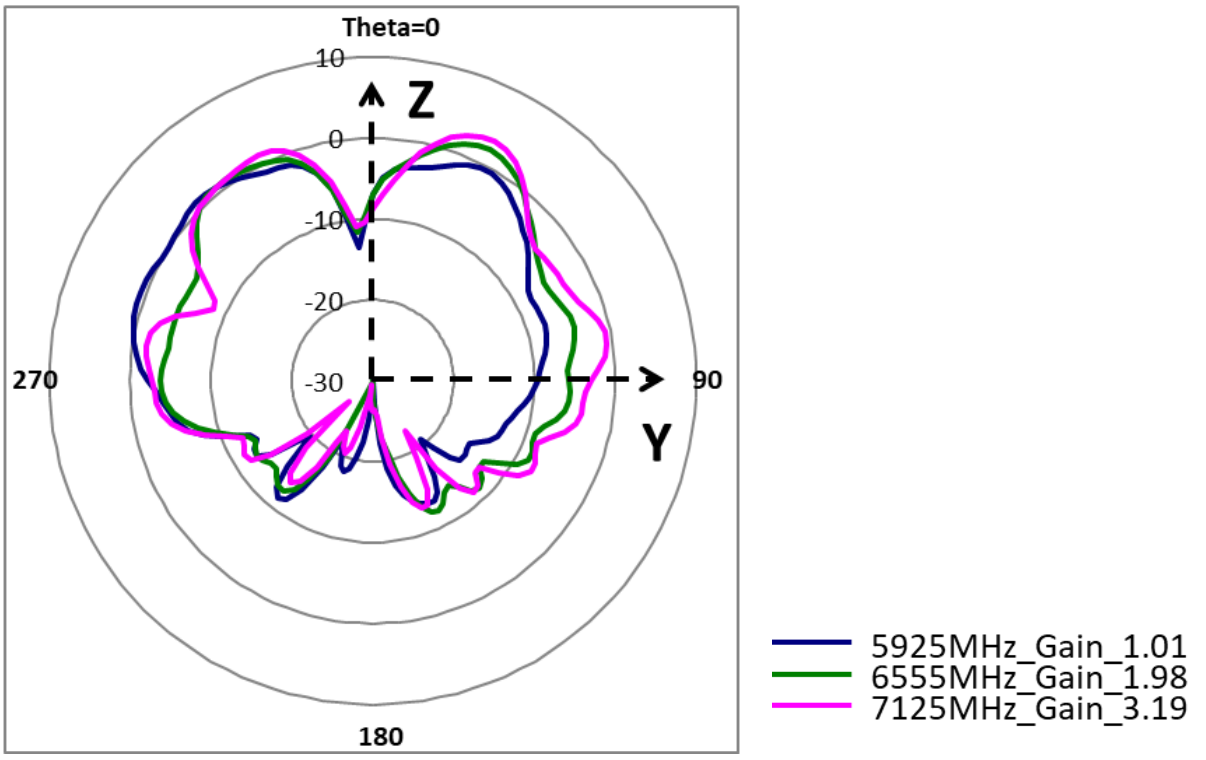
XZ_Pol._Theta_Ant.8



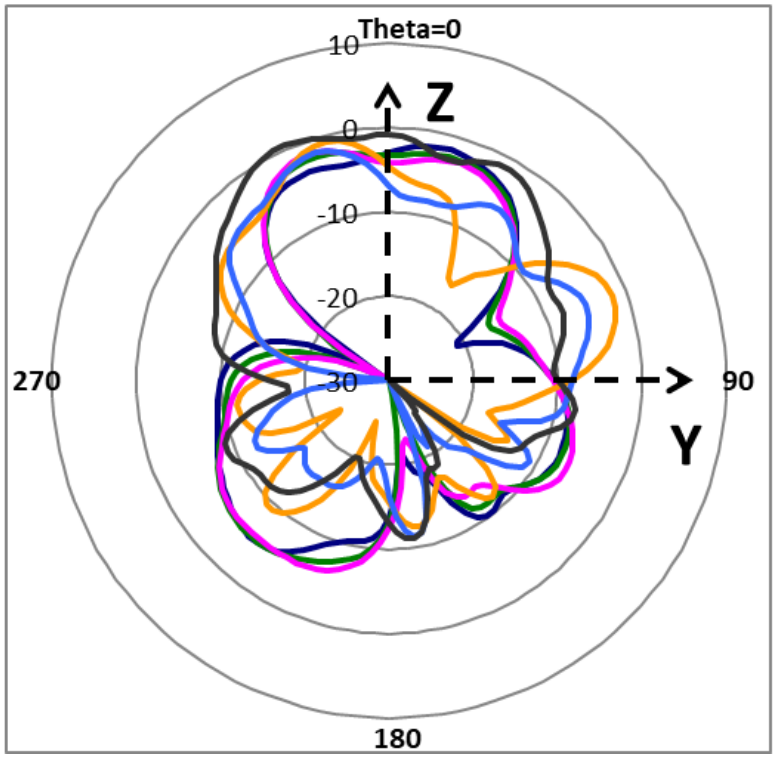
YZ_Pol._Phi_Ant.5



YZ_Pol._Phi_Ant.6

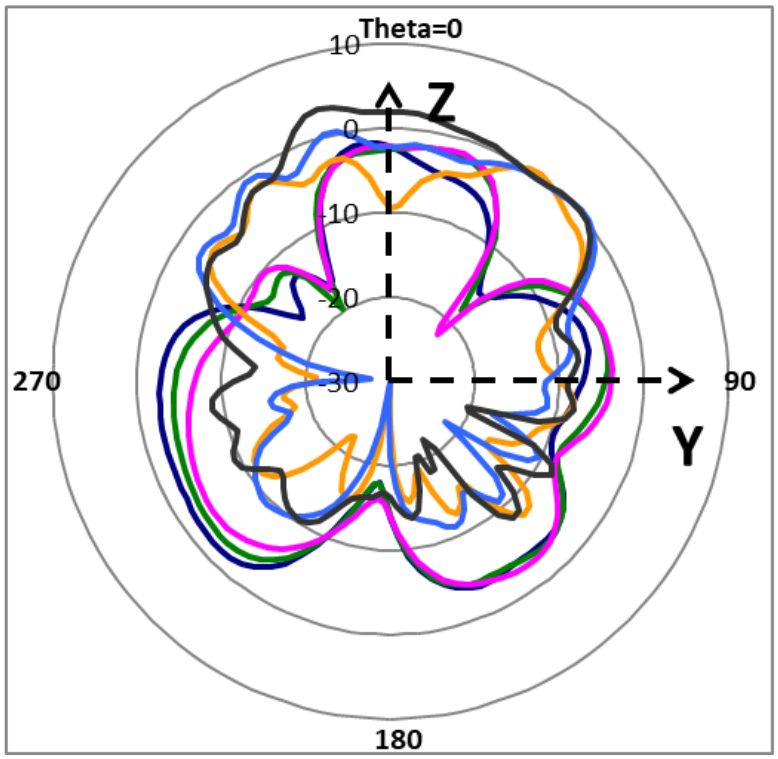


YZ_Pol._Phi_Ant.7



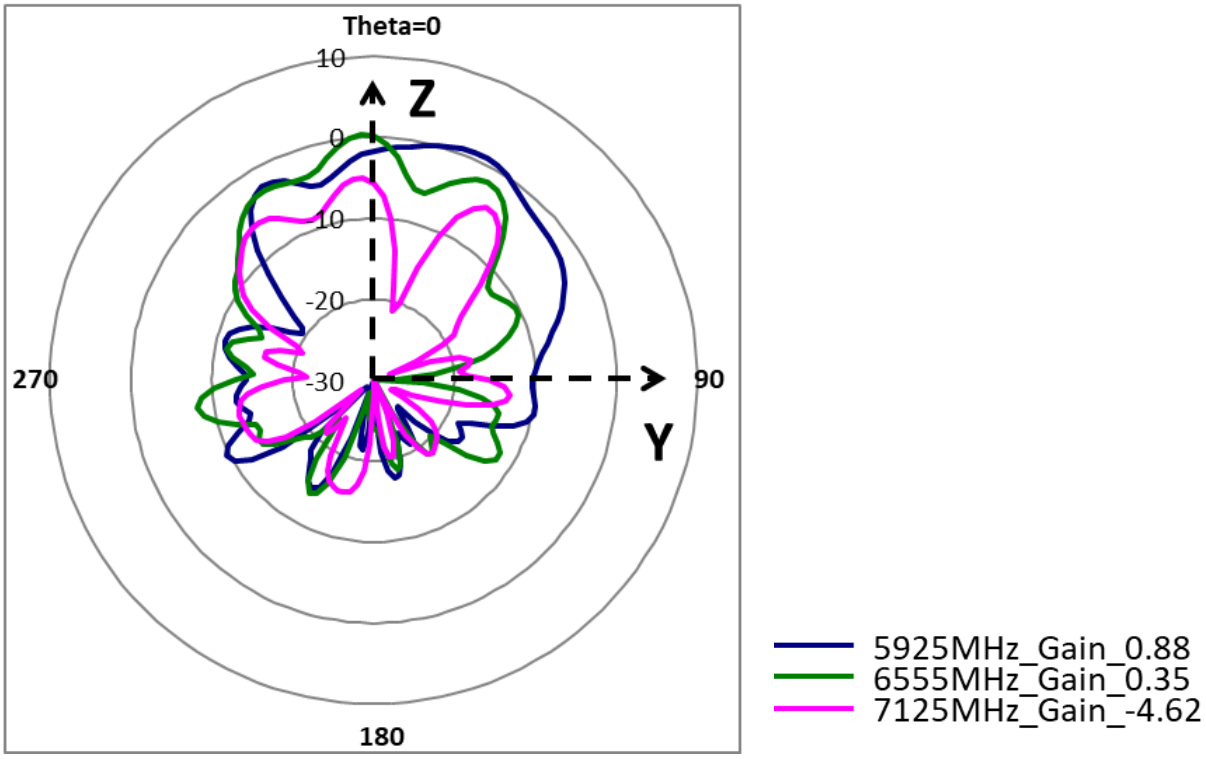
2401MHz_Gain_-1.68
2452MHz_Gain_-2.00
2484MHz_Gain_-1.46
5925MHz_Gain_-0.67
6555MHz_Gain_-1.54
7125MHz_Gain_0.60

YZ_Pol._Phi_Ant.8

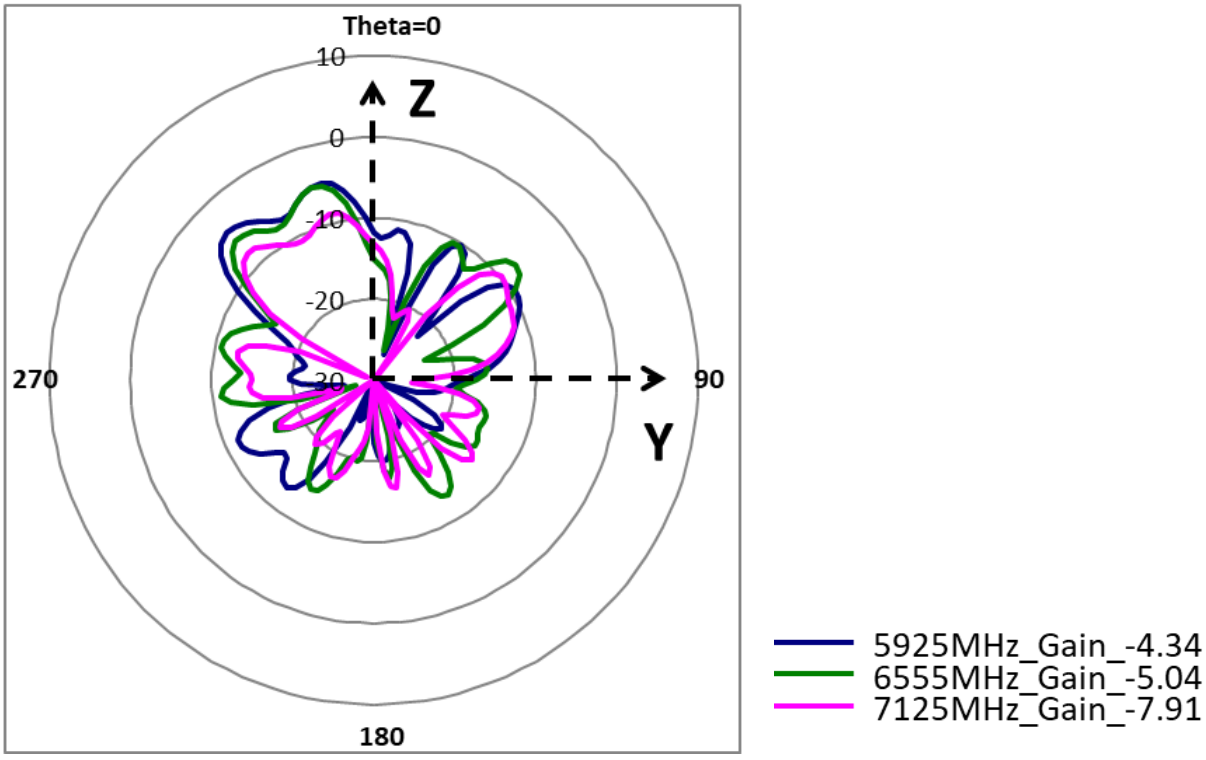


2401MHz_Gain_-1.56
2452MHz_Gain_-1.86
2484MHz_Gain_-1.68
5925MHz_Gain_0.32
6555MHz_Gain_0.39
7125MHz_Gain_3.38

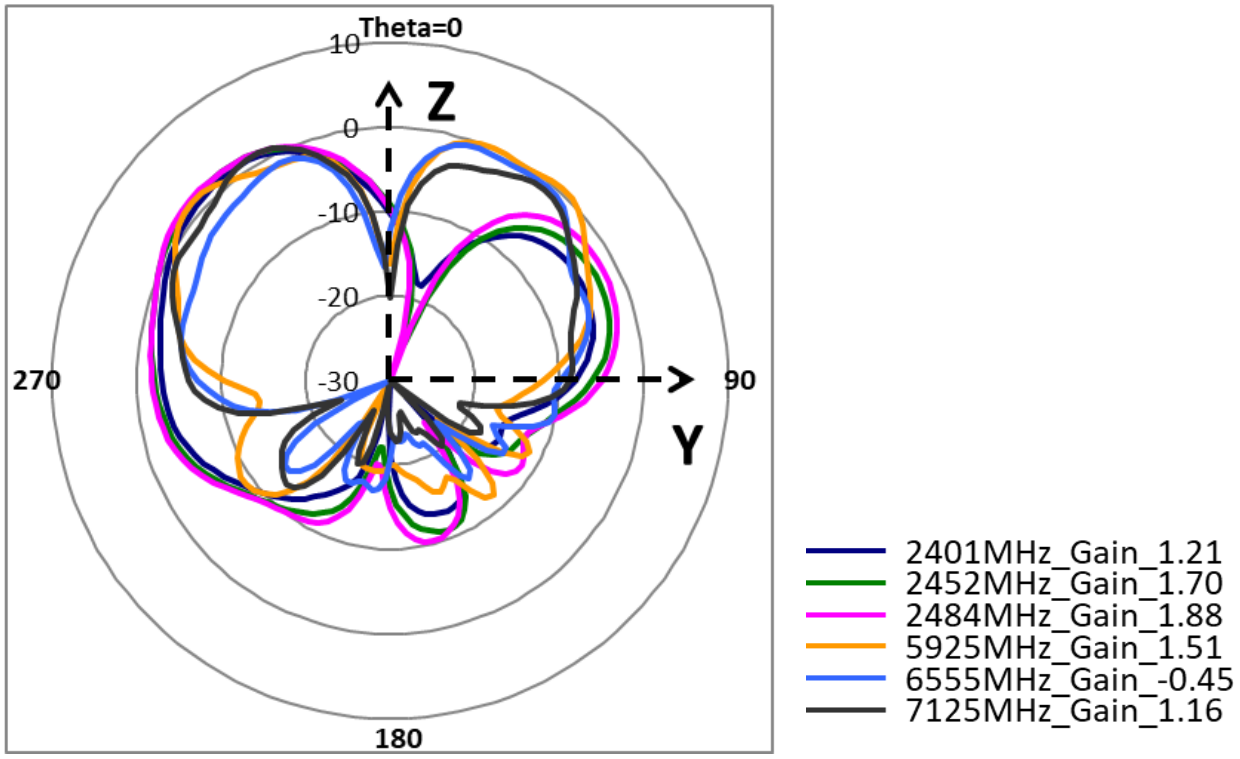
YZ_Pol._Theta_Ant.5



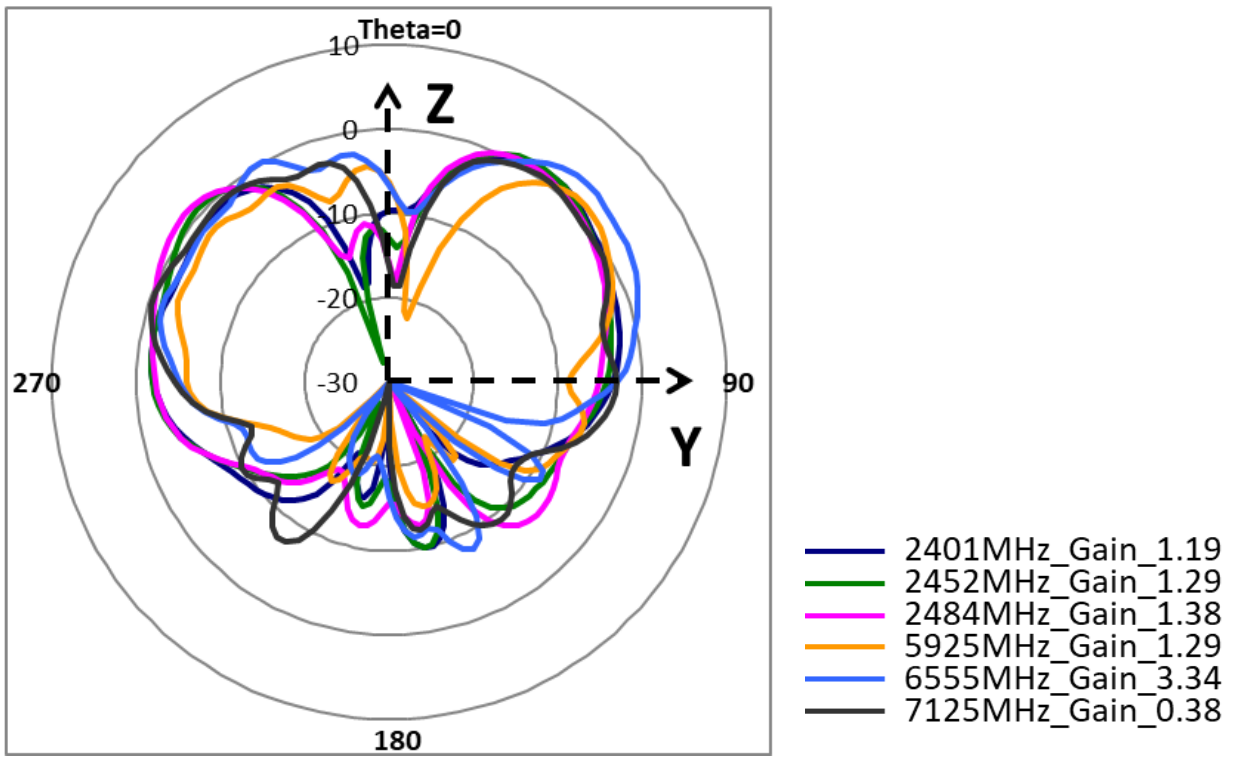
YZ_Pol._Theta_Ant.6



YZ_Pol._Theta_Ant.7

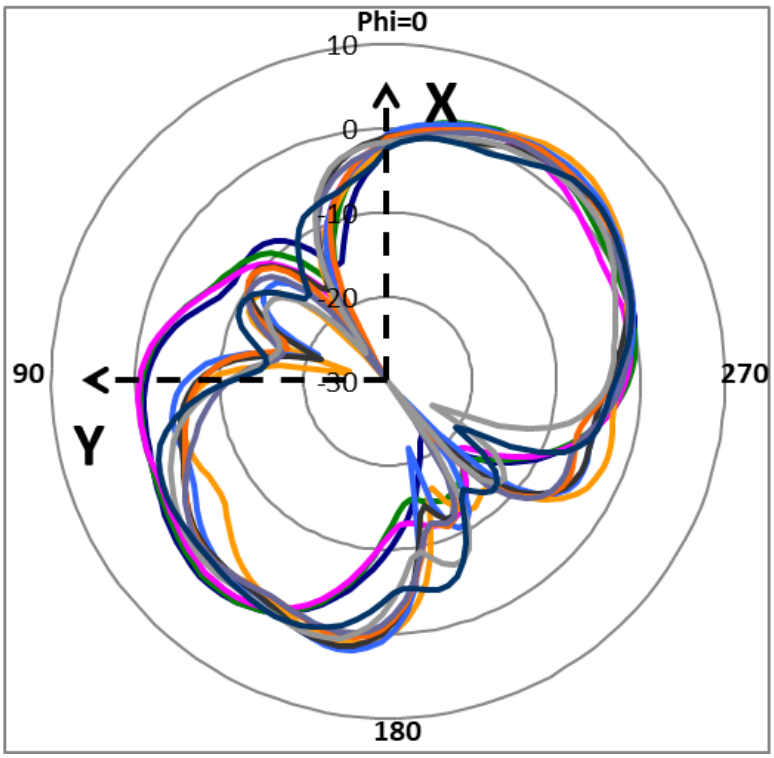


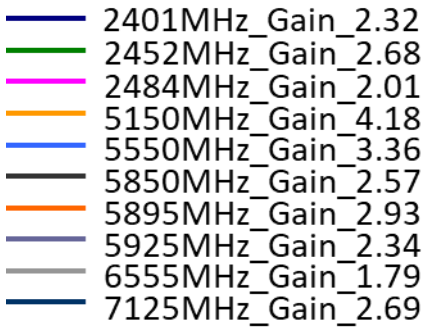
YZ_Pol._Theta_Ant.8



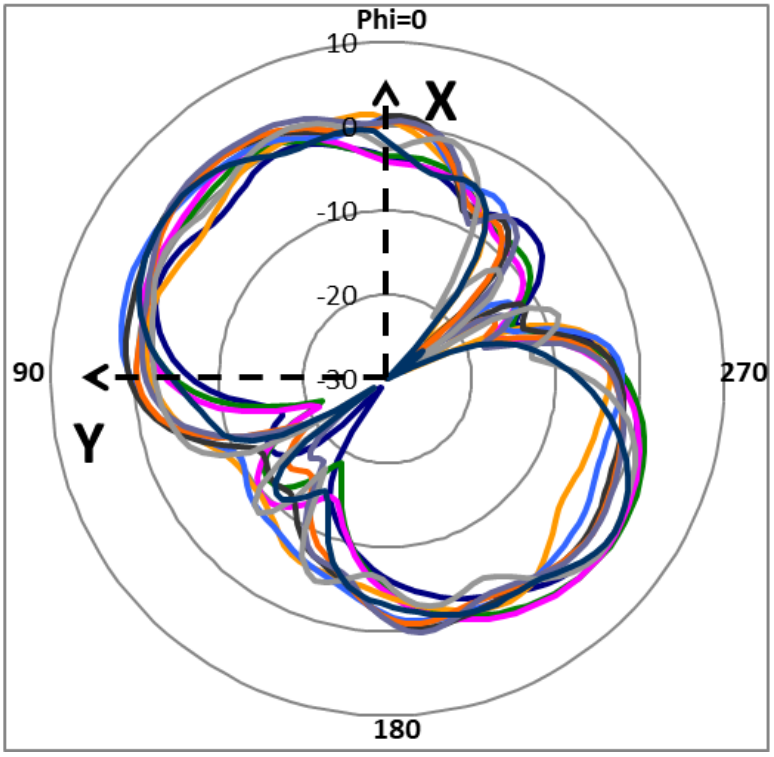
Ant. Position：2G/5G/6G Ant.9~12

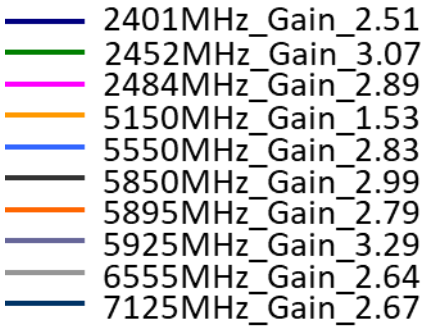
XY_Pol._Phi_Ant.9



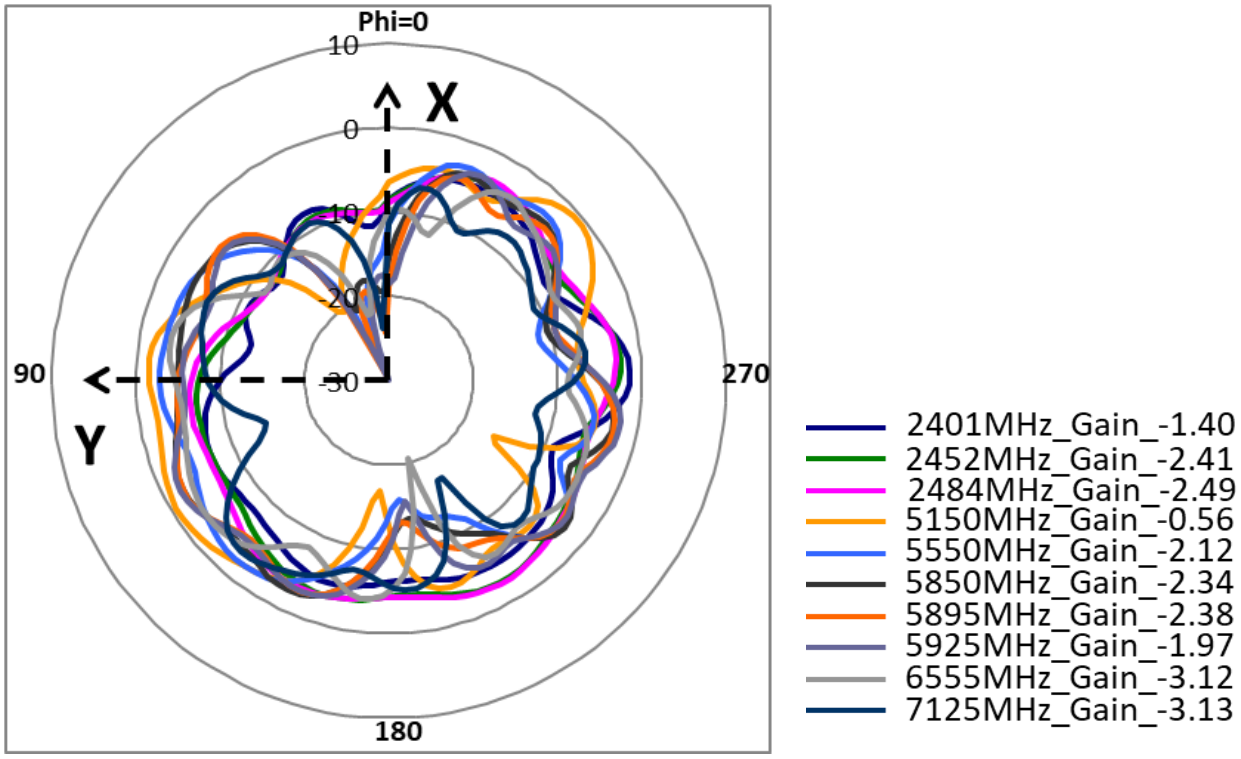


XY_Pol._Phi_Ant.10

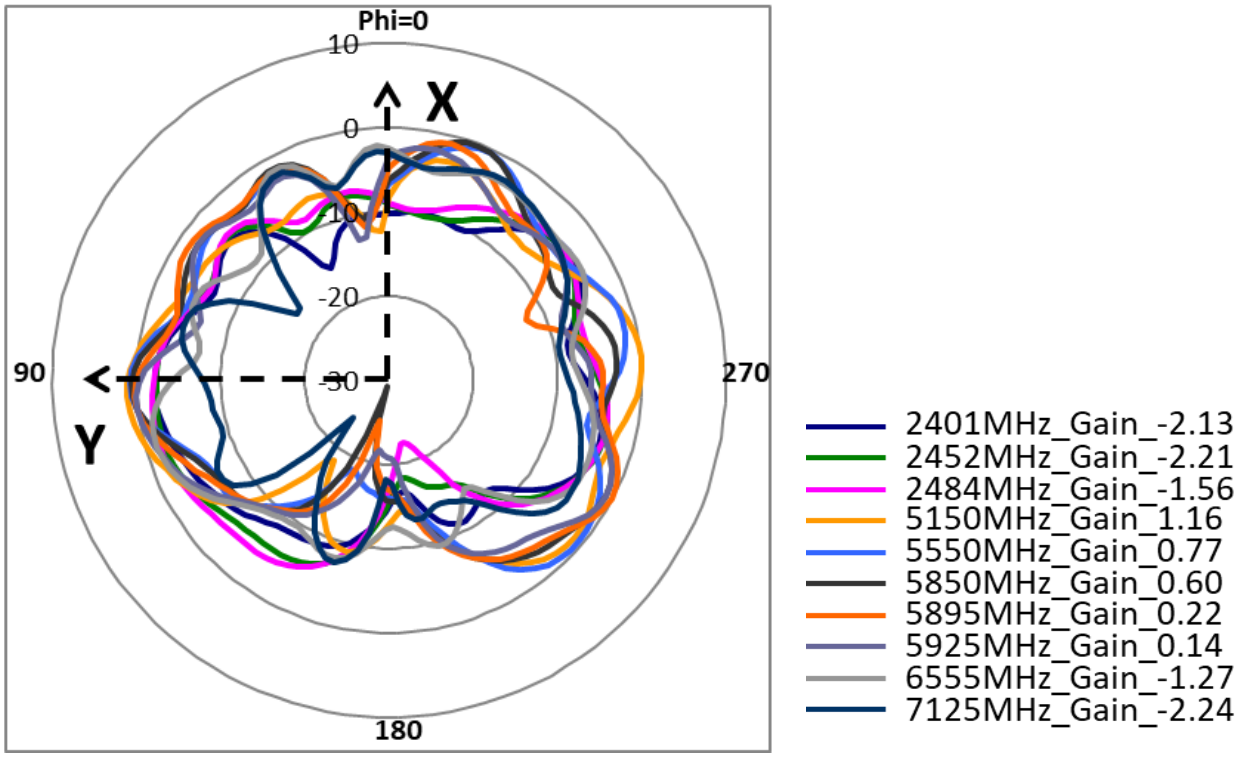




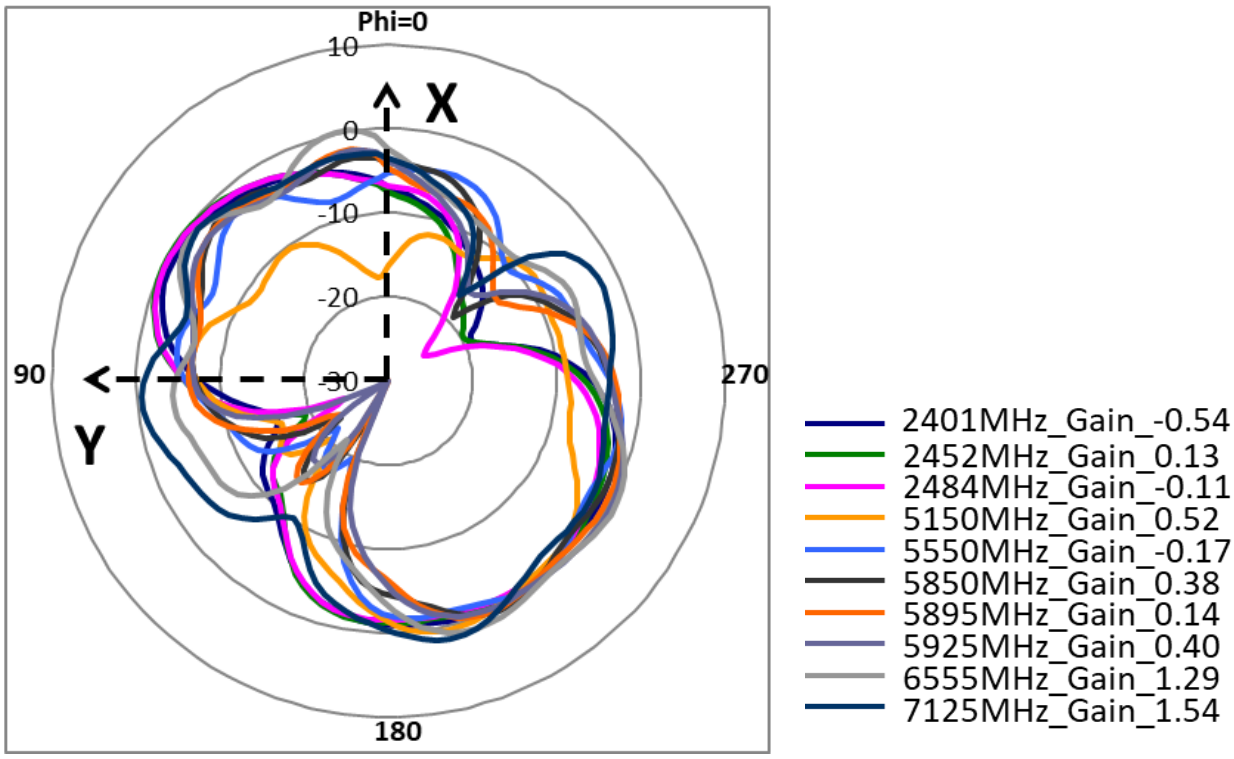
XY_Pol._Phi_Ant.11



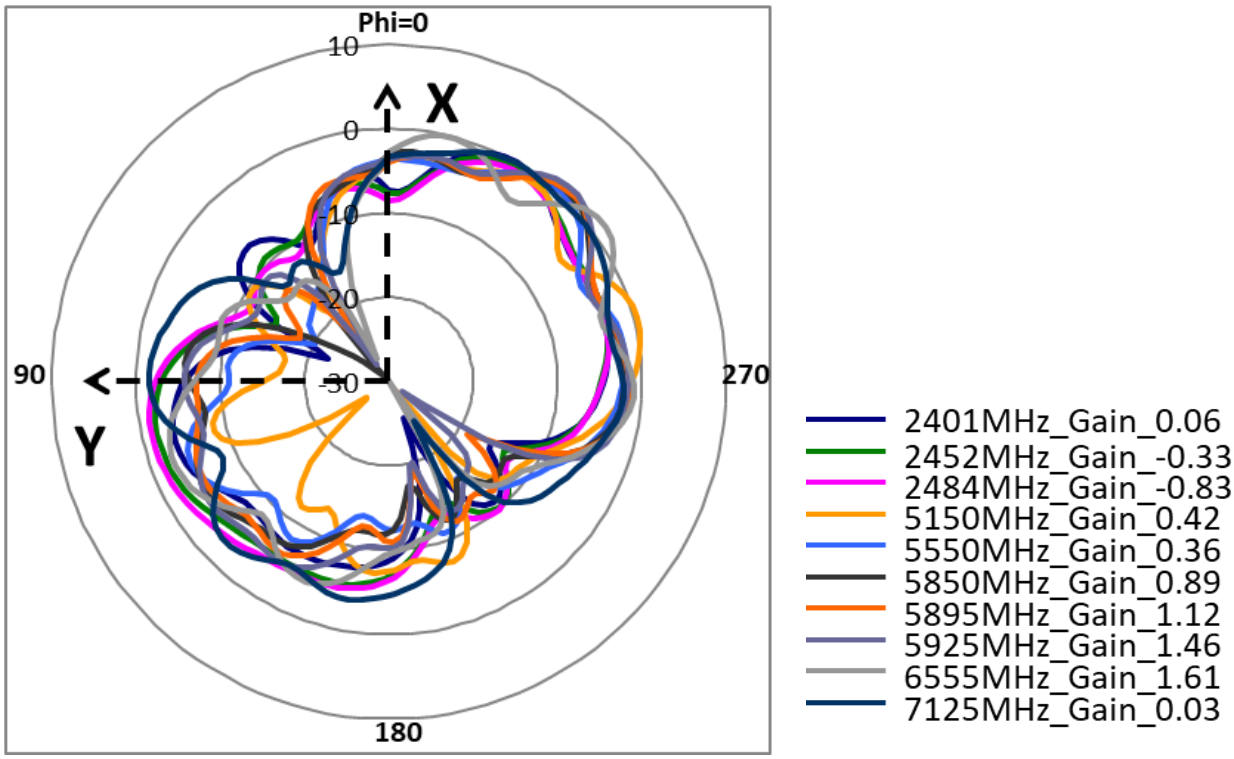
XY_Pol._Phi_Ant.12



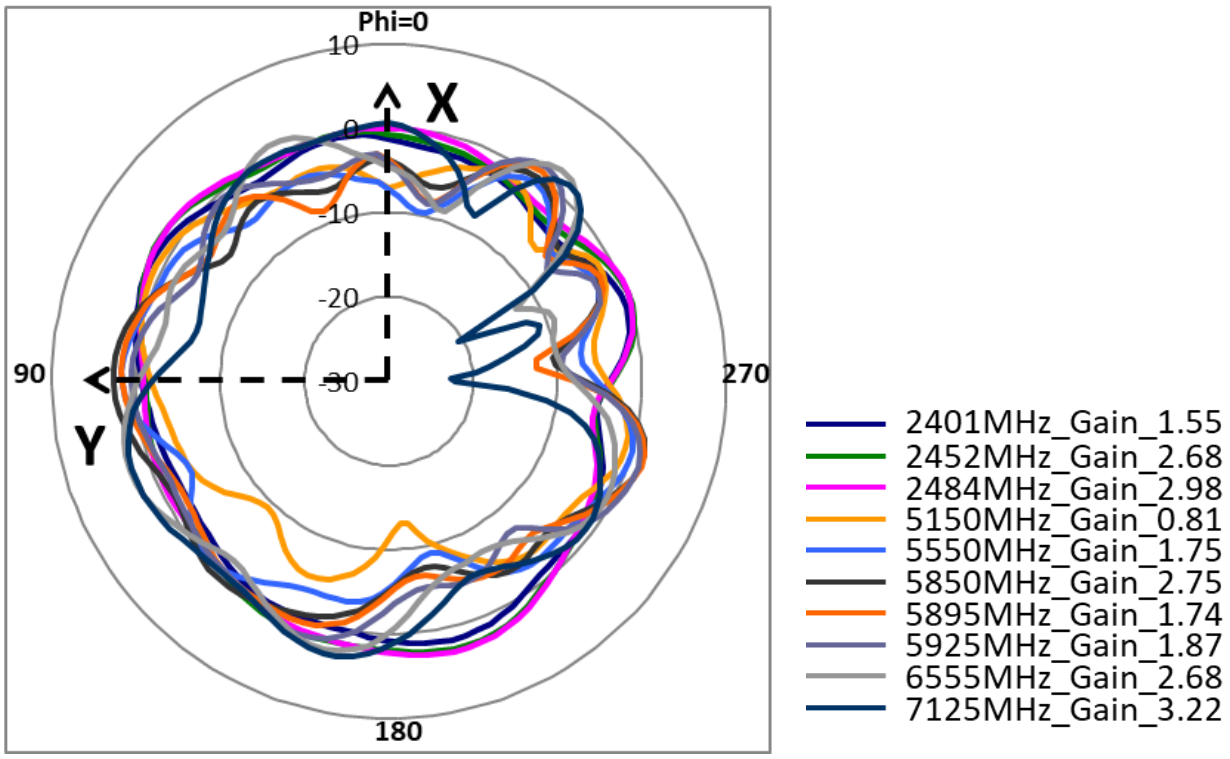
XY_Pol._Theta_Ant.9



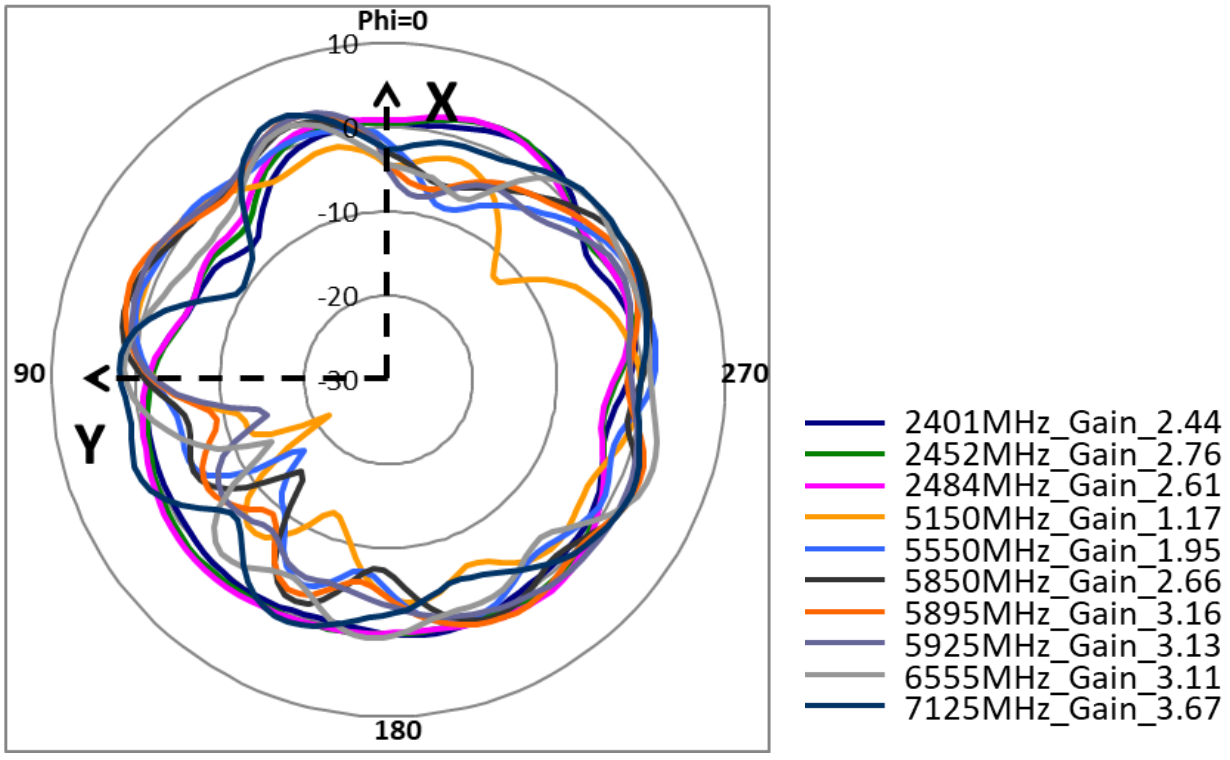
XY_Pol._Theta_Ant.10



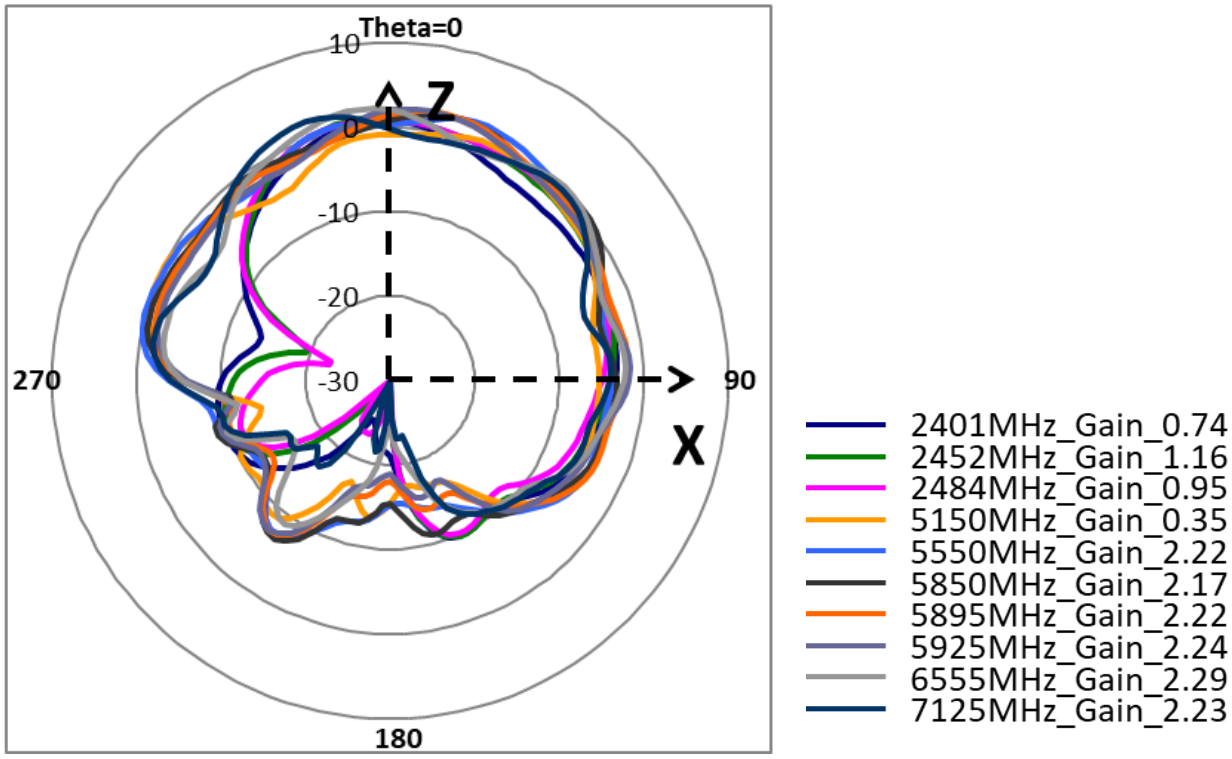
XY_Pol._Theta_Ant.11



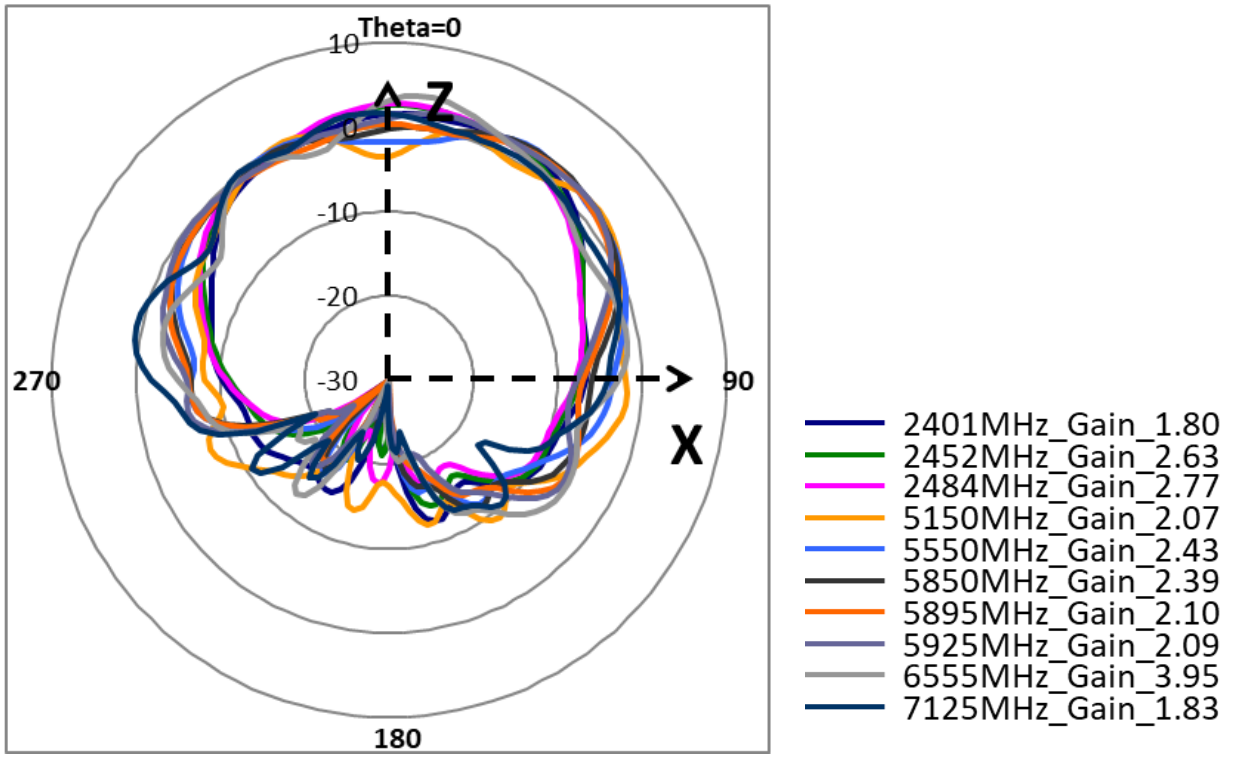
XY_Pol._Theta_Ant.12



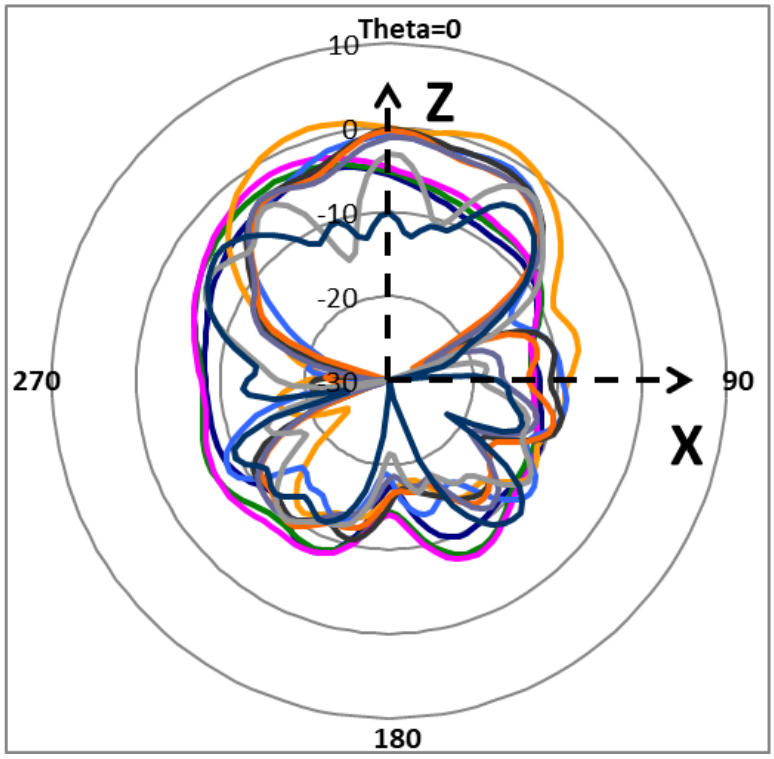
XZ_Pol._Phi_Ant.9



XZ_Pol._Phi_Ant.10

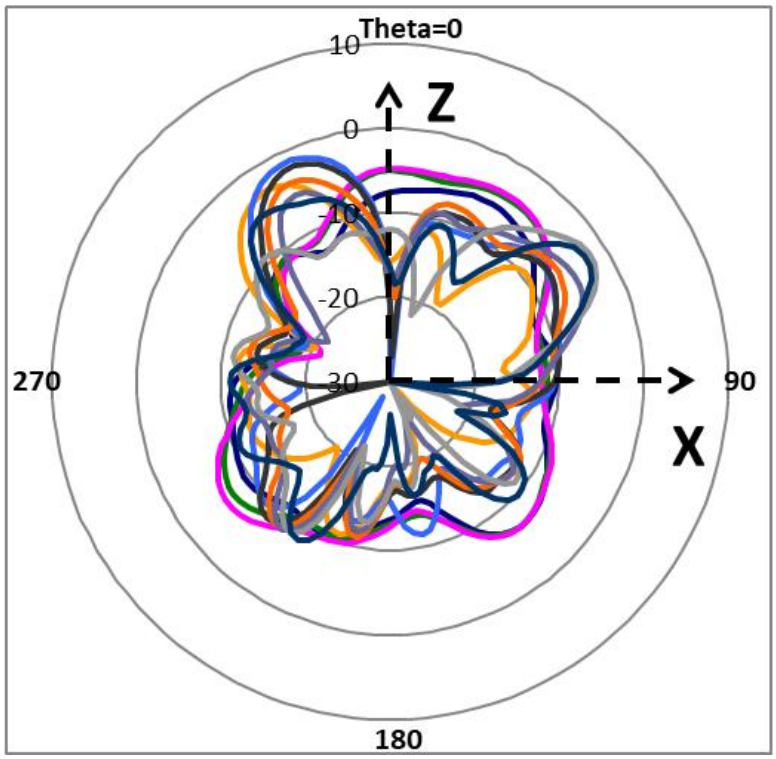


XZ_Pol._Phi_Ant.11



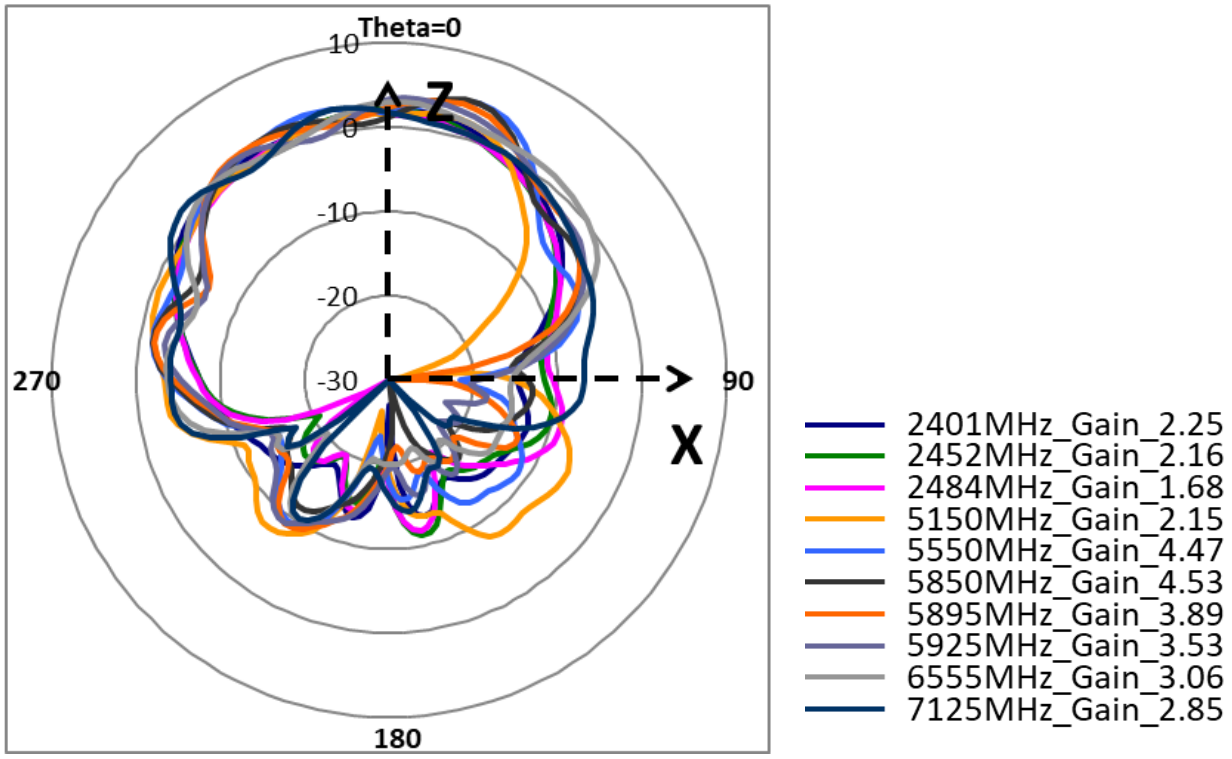
2401MHz_Gain_-3.94
2452MHz_Gain_-2.85
2484MHz_Gain_-1.80
5150MHz_Gain_1.36
5550MHz_Gain_-0.92
5850MHz_Gain_-0.18
5895MHz_Gain_-0.29
5925MHz_Gain_-1.13
6555MHz_Gain_-2.15
7125MHz_Gain_-4.56

XZ_Pol._Phi_Ant.12

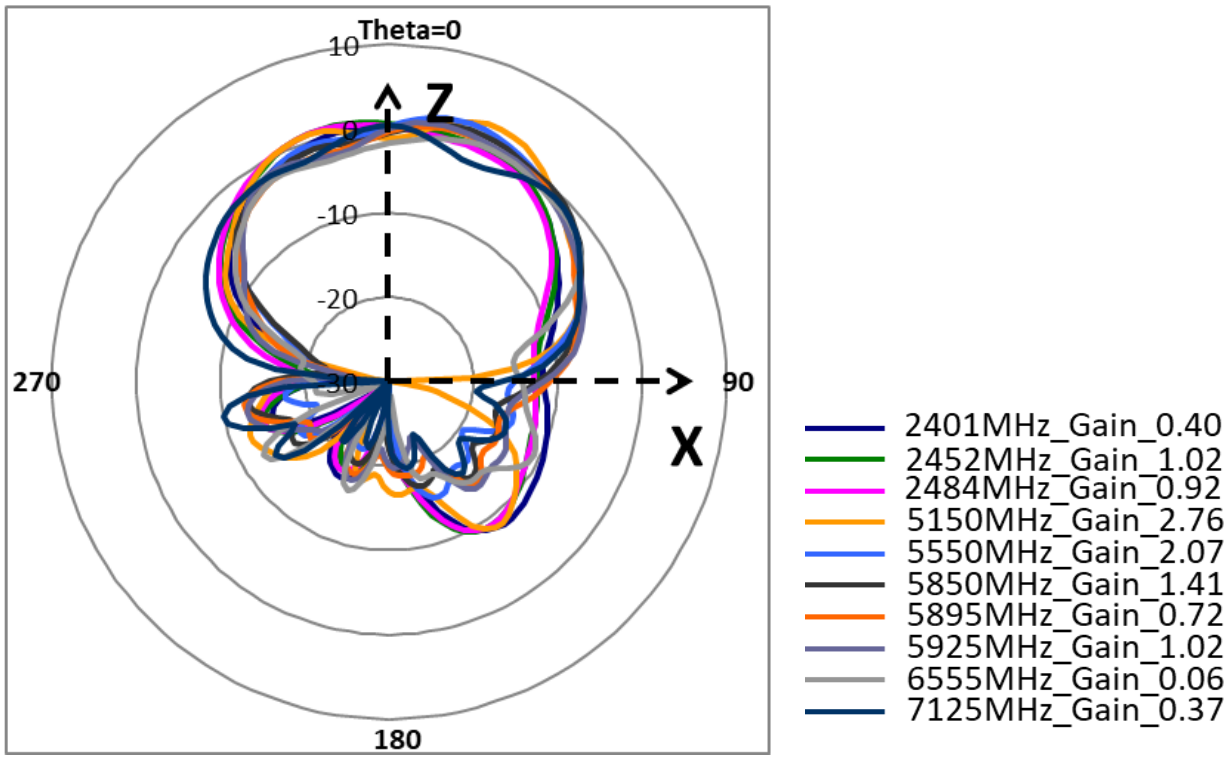


2401MHz_Gain_-5.81
2452MHz_Gain_-4.24
2484MHz_Gain_-3.81
5150MHz_Gain_-3.00
5550MHz_Gain_-1.28
5850MHz_Gain_-2.10
5895MHz_Gain_-3.74
5925MHz_Gain_-4.79
6555MHz_Gain_-1.96
7125MHz_Gain_-2.56

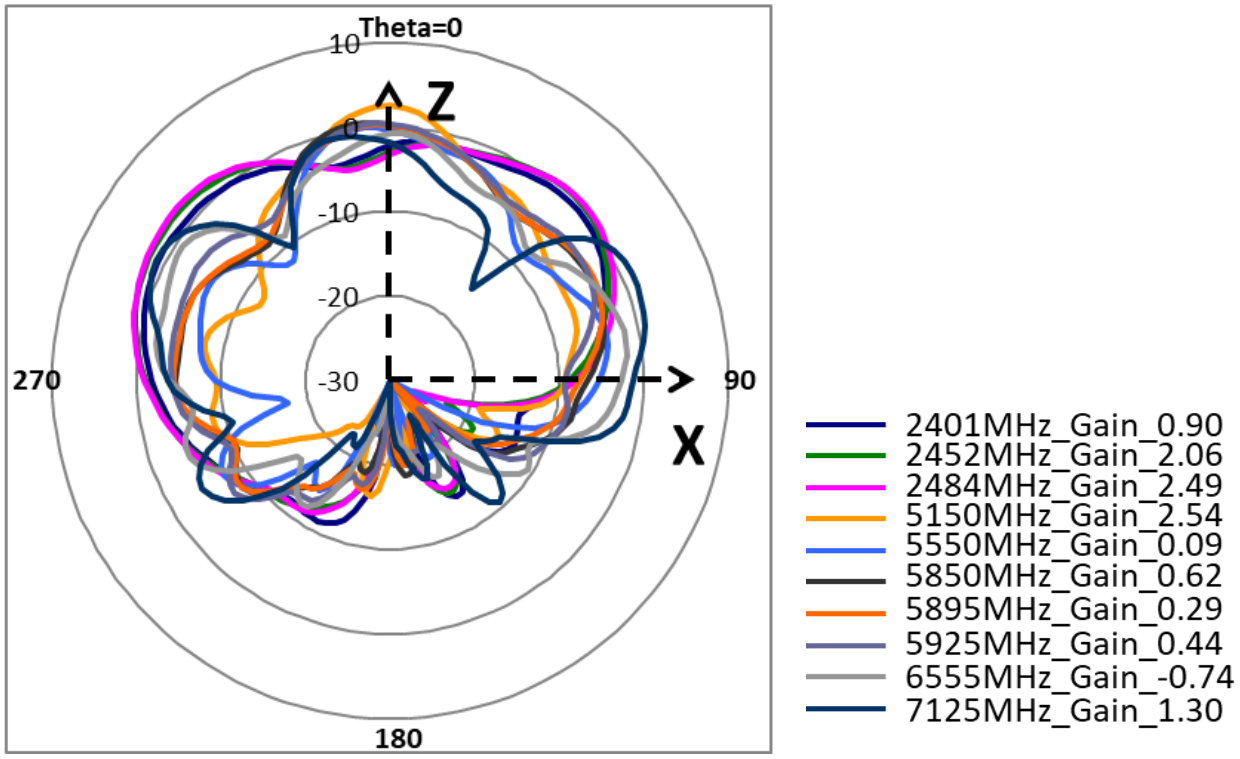
XZ_Pol._Theta_Ant.9



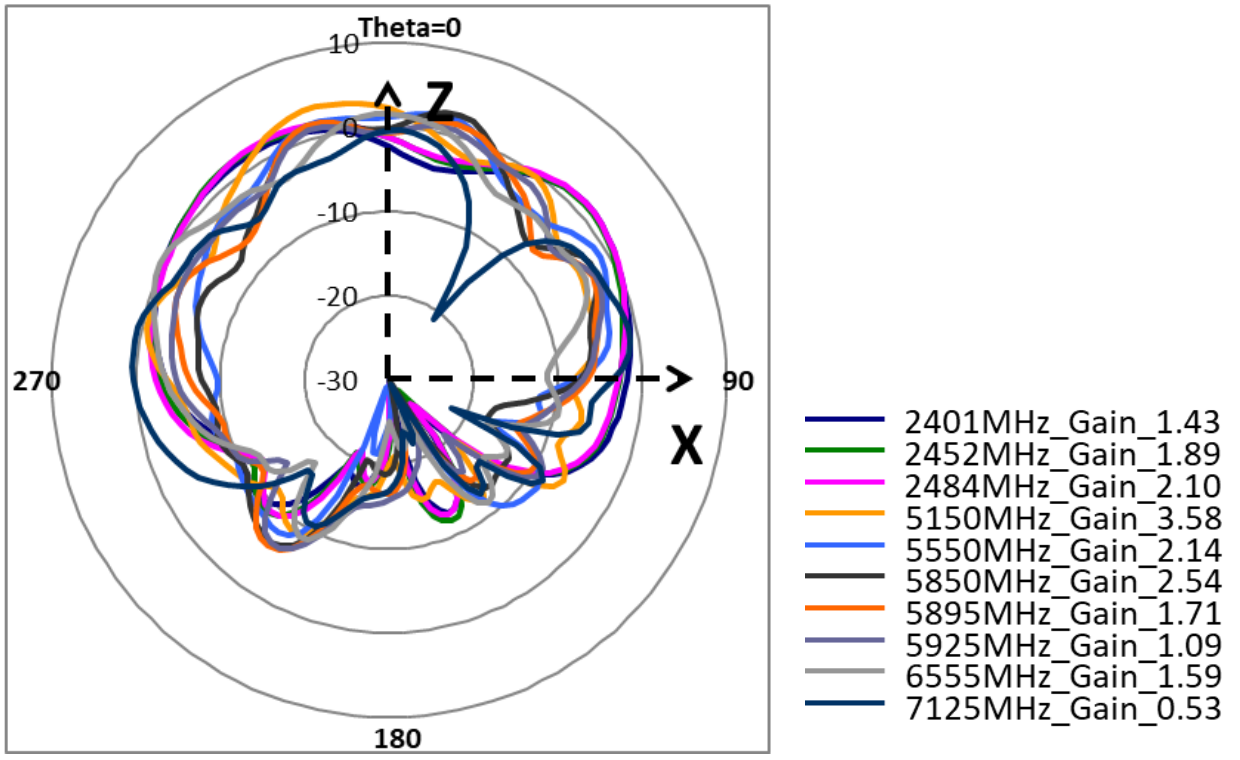
XZ_Pol._Theta_Ant.10



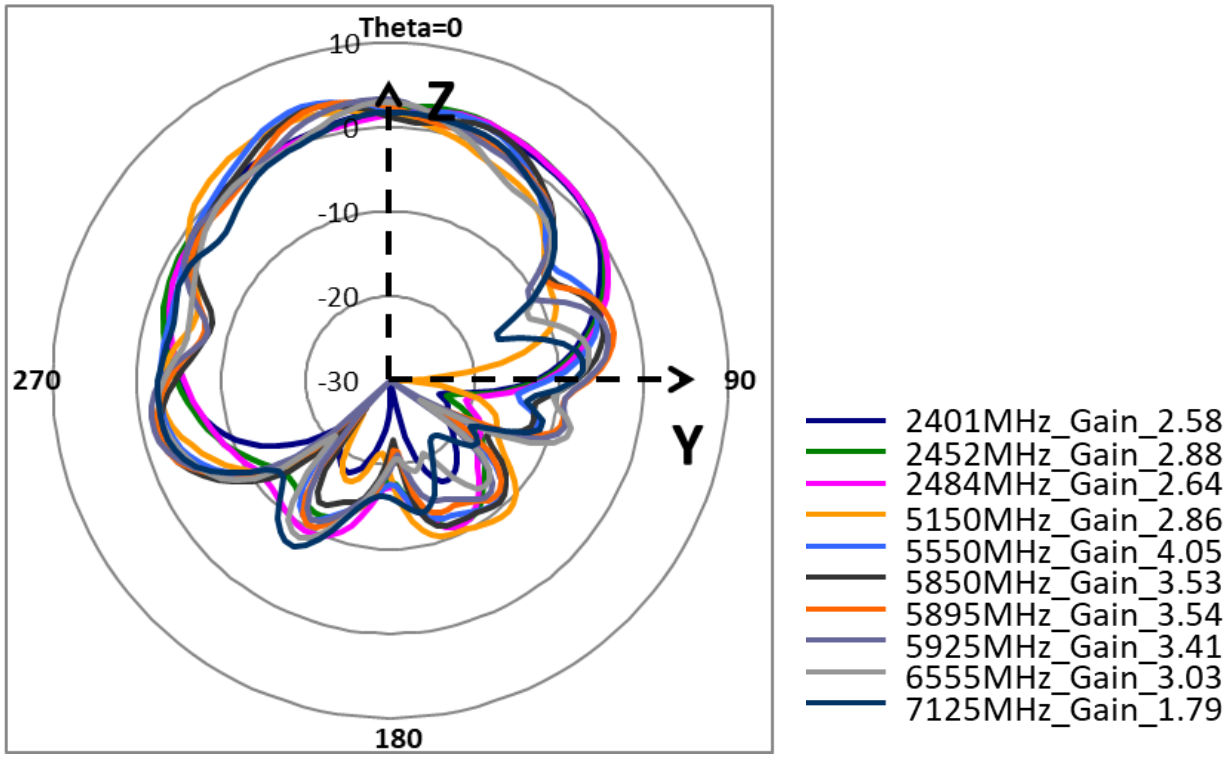
XZ_Pol._Theta_Ant.11



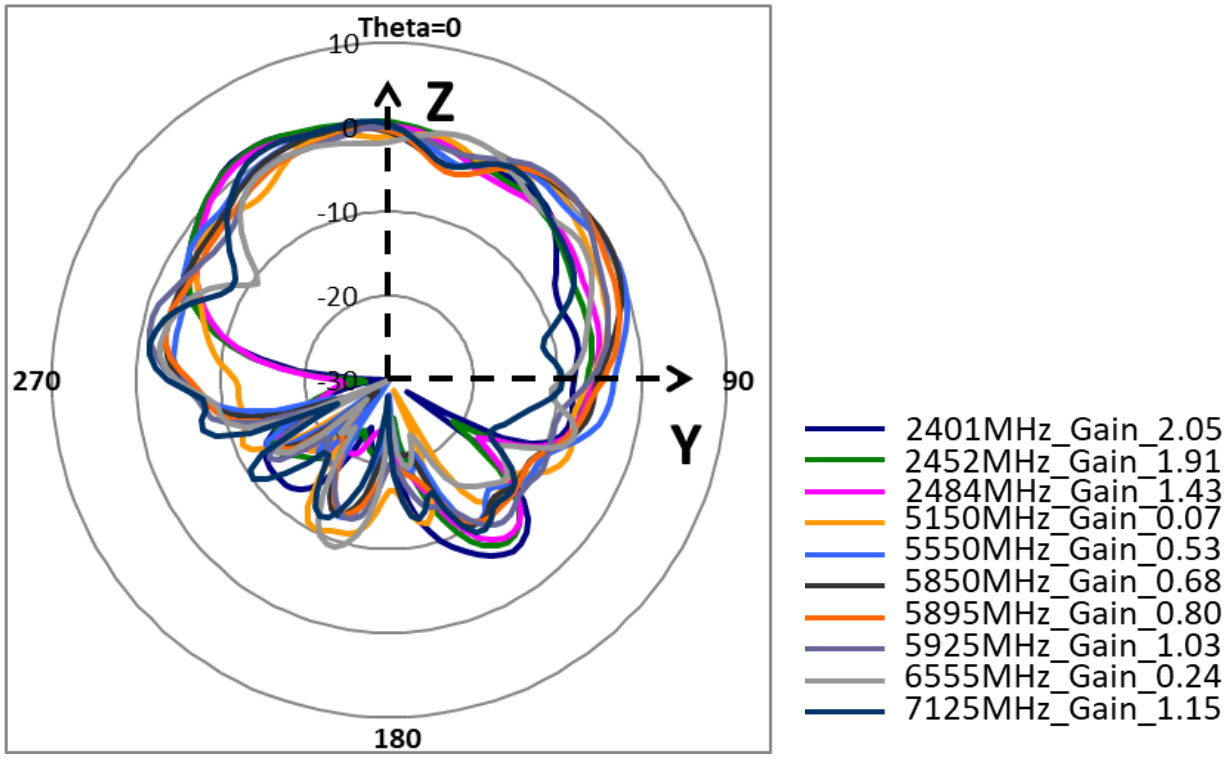
XZ_Pol._Theta_Ant.12



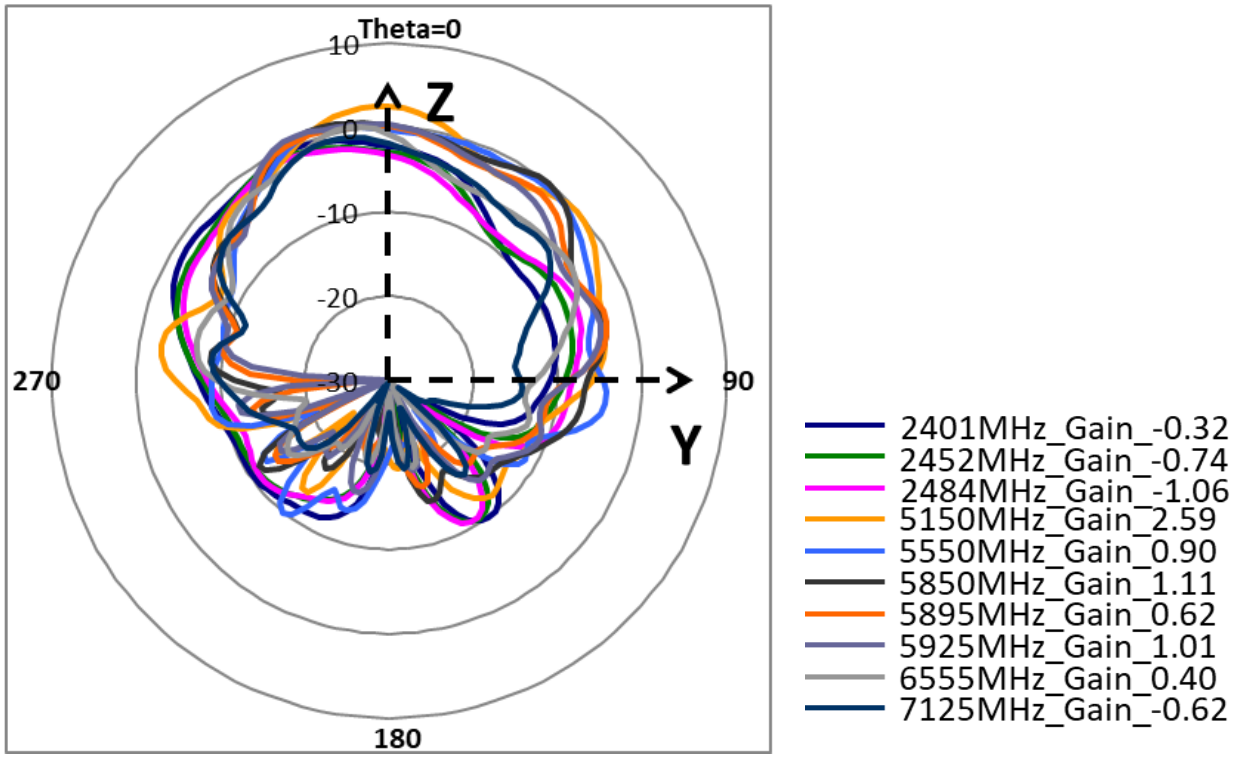
YZ_Pol._Phi_Ant.9



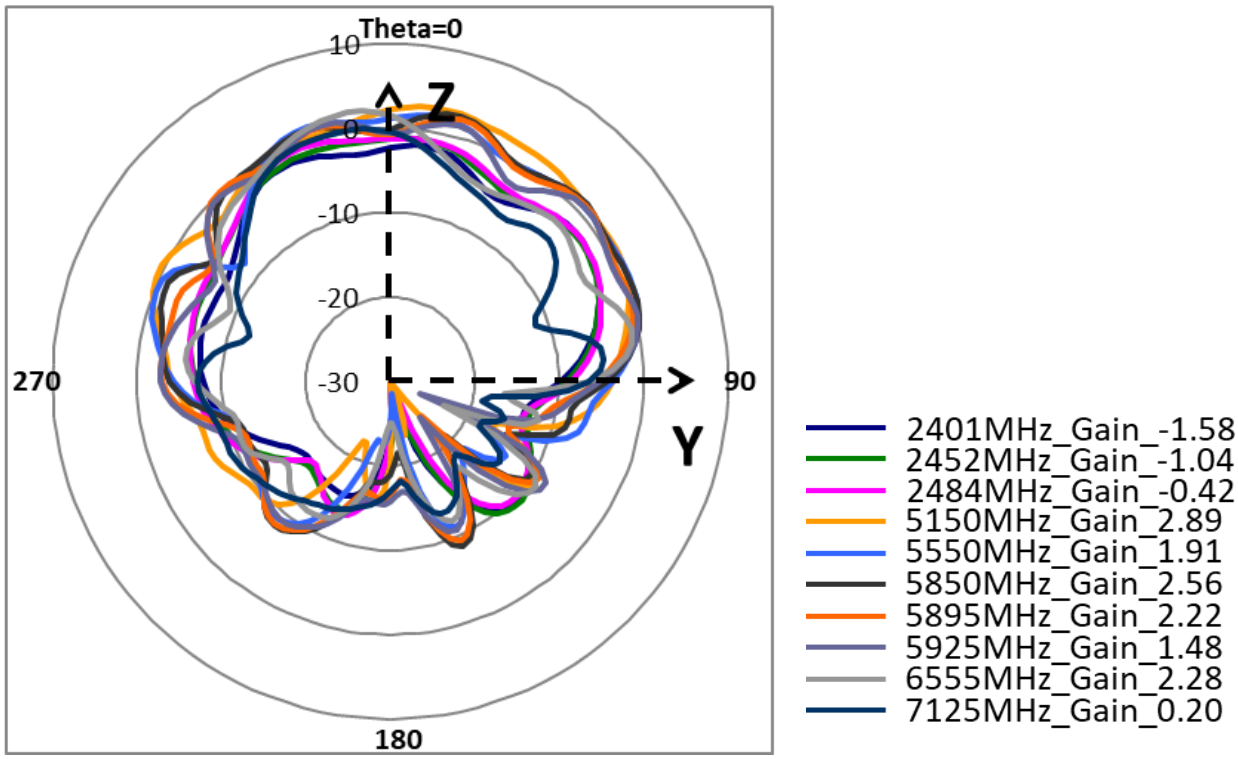
YZ_Pol._Phi_Ant.10



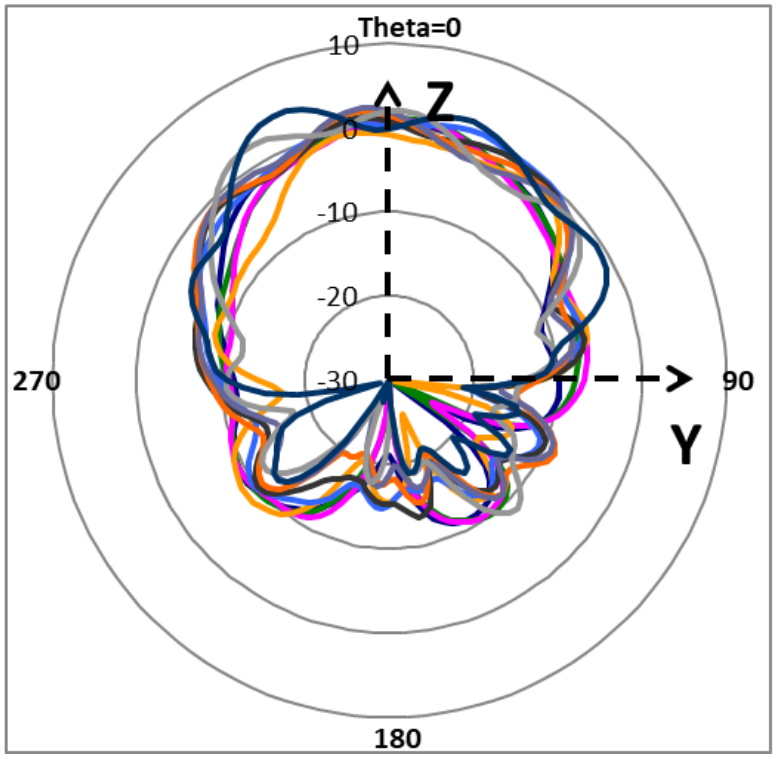
YZ_Pol._Phi_Ant.11



YZ_Pol._Phi_Ant.12

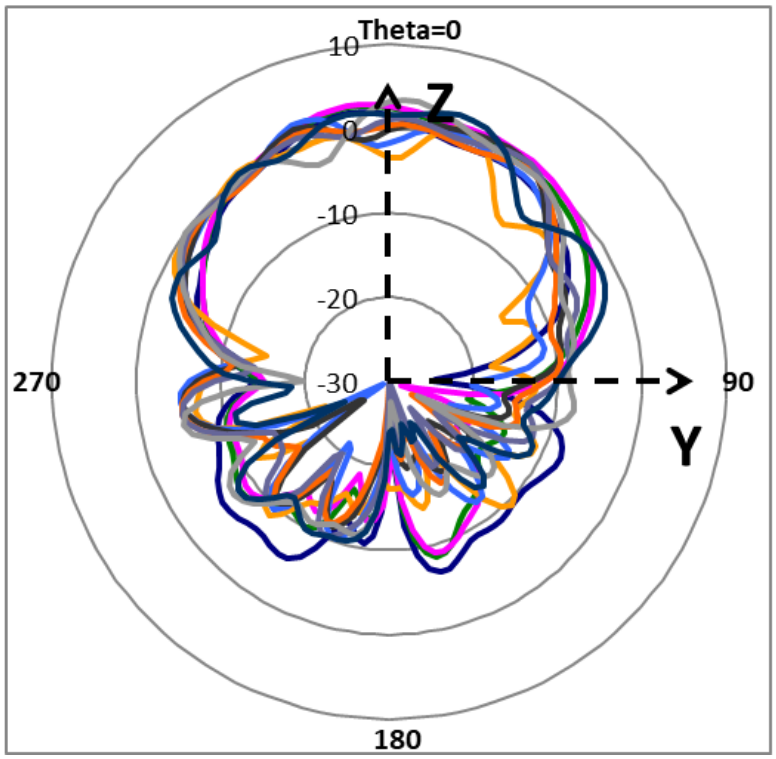


YZ_Pol._Theta_Ant.9



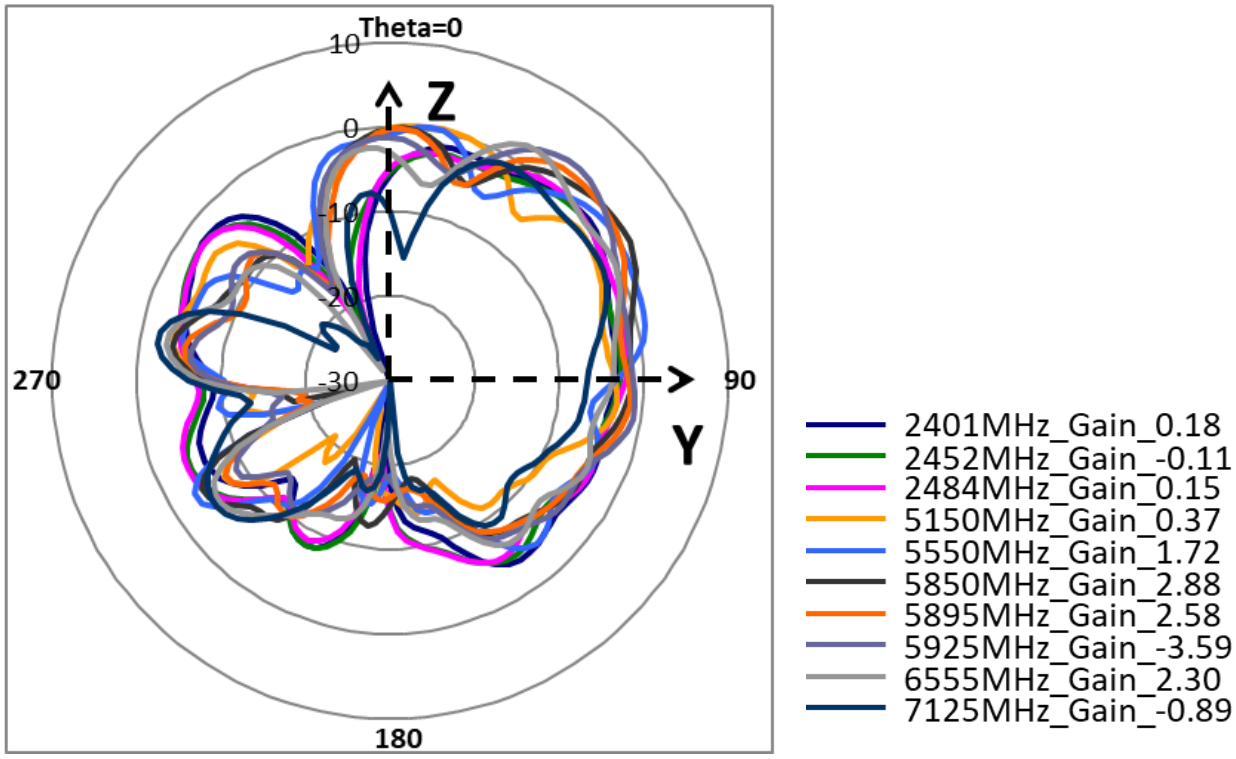
2401MHz_Gain_0.79
2452MHz_Gain_1.15
2484MHz_Gain_0.98
5150MHz_Gain_-0.32
5550MHz_Gain_1.23
5850MHz_Gain_1.38
5895MHz_Gain_2.07
5925MHz_Gain_2.43
6555MHz_Gain_2.31
7125MHz_Gain_4.29

YZ_Pol._Theta_Ant.10



2401MHz_Gain_2.30
2452MHz_Gain_2.93
2484MHz_Gain_3.07
5150MHz_Gain_1.16
5550MHz_Gain_2.61
5850MHz_Gain_1.92
5895MHz_Gain_1.19
5925MHz_Gain_1.33
6555MHz_Gain_3.48
7125MHz_Gain_2.67

YZ_Pol._Theta_Ant.11



YZ_Pol._Theta_Ant.12