GALTRONICS

WHEN CONNECTIONS COUNT

Vantiva ATT WiFi 7 PON Gateway Triband Antenna Performance Report

Galtronics Project: 7908

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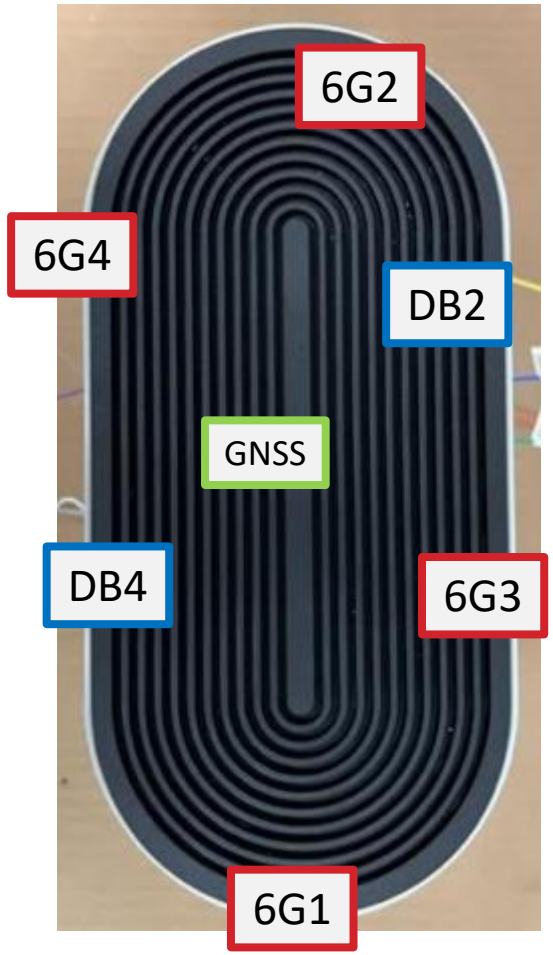
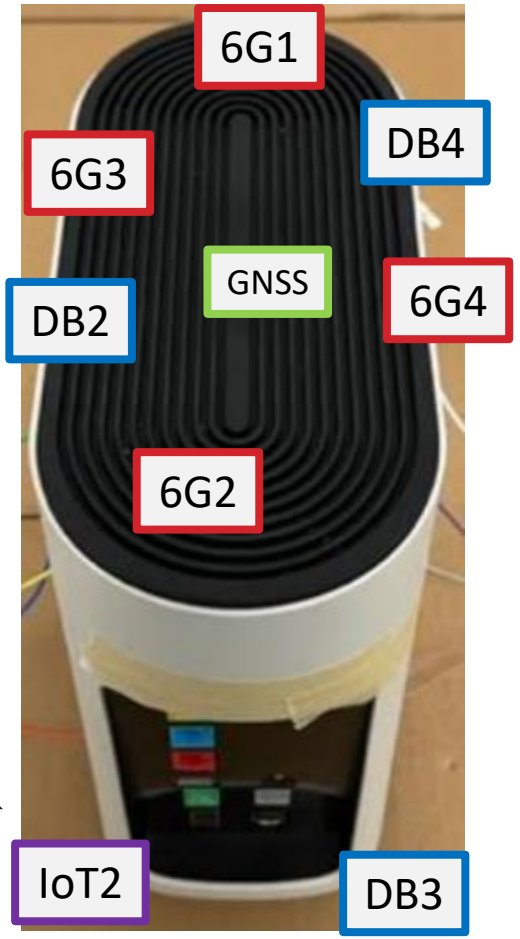
April 08, 2024

Introduction

- Galtronics developed an antenna solution for Vantiva ATT WiFi7
- Galtronics received the production unit (Hardware version 1.5).
- DB1, DB3 and GNSS tuned for better performance
- There are 11 antennas
  - Four PCB Dual Band antennas (DB1, DB2, DB3, and DB4) and Four PCB 6 GHz antennas (6G1, 6G2, 6G3 and 6G4)
  - Two PCB IoT/DFS antennas (IoT1-DFS and IoT2), One PCB GNSS antennas
- The operating frequency of the Dual band Antennas is 2.4 GHz-2.5 GHz and 5.15 GHz-5.825 GHz.
- The operation Frequency of 6GHz is 5.925 GHz - 7.125 GHz.
- The operation Frequency of IoT is 2.4 GHz - 2.5 GHz.
- The operation Frequency of DFS is 5.15 GHz - 7.125 GHz.
- The operation Frequency of GNSS is at 1.575 GHz.
- Measured return loss, isolation, peak gain, efficiency, composite gain, gain pattern, 3d gain pattern, and H-pol and V-pol gain patterns.

Antenna Location

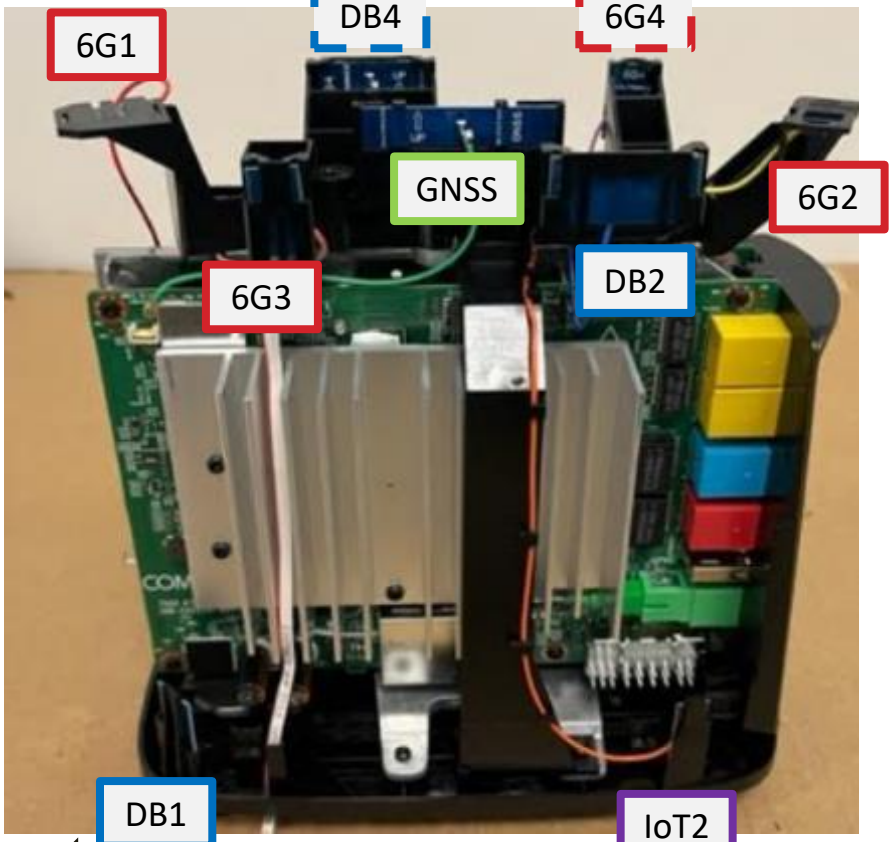


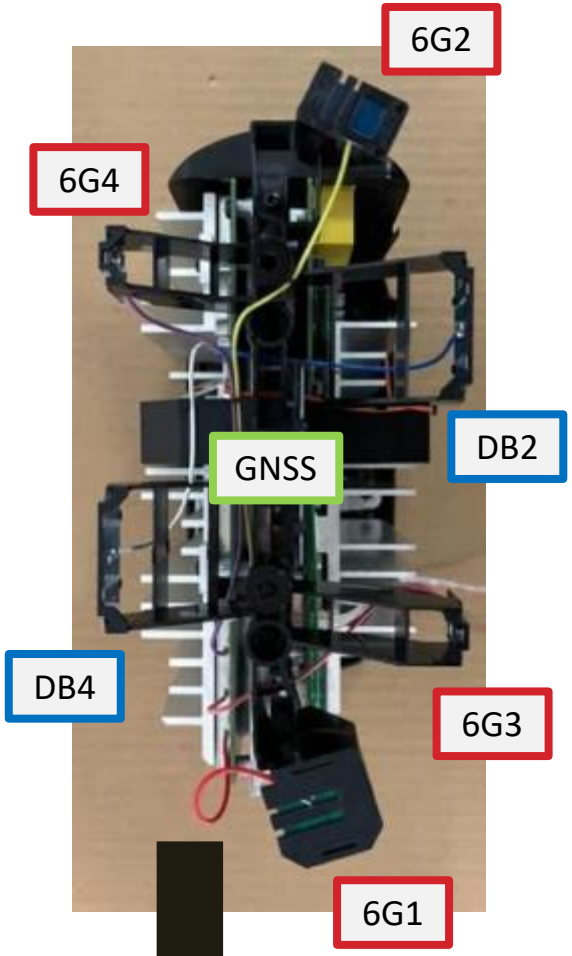


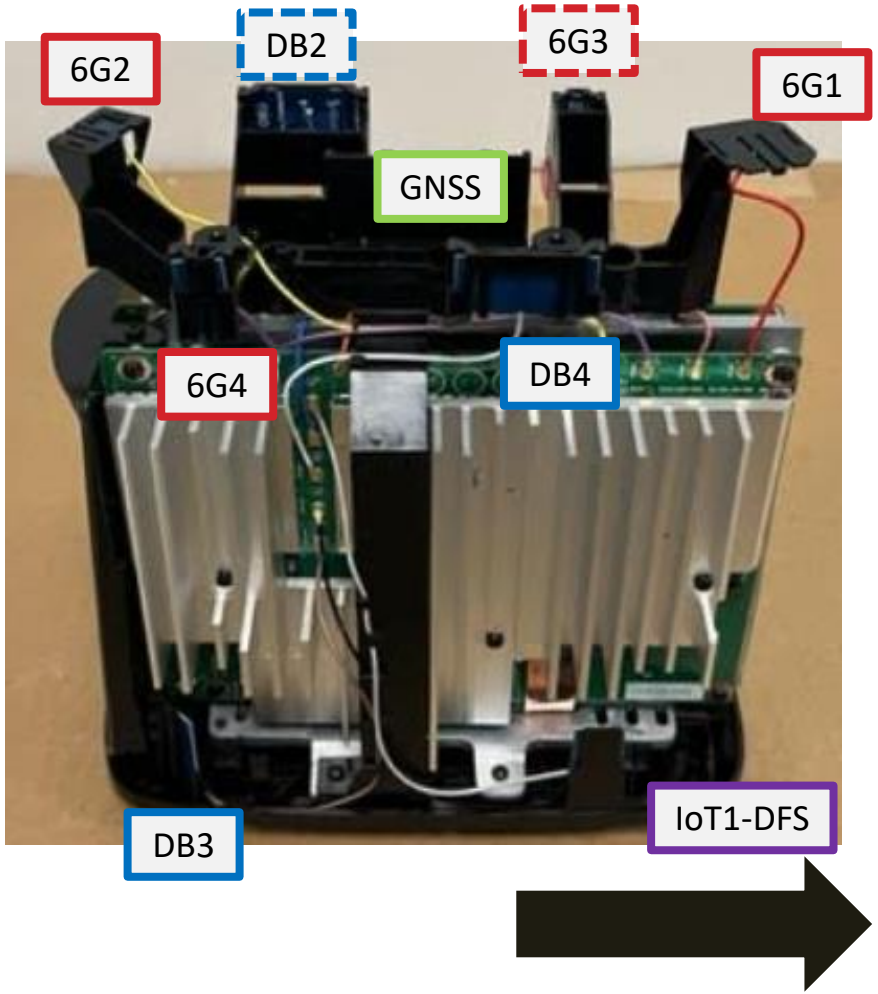
Front

Z-direction

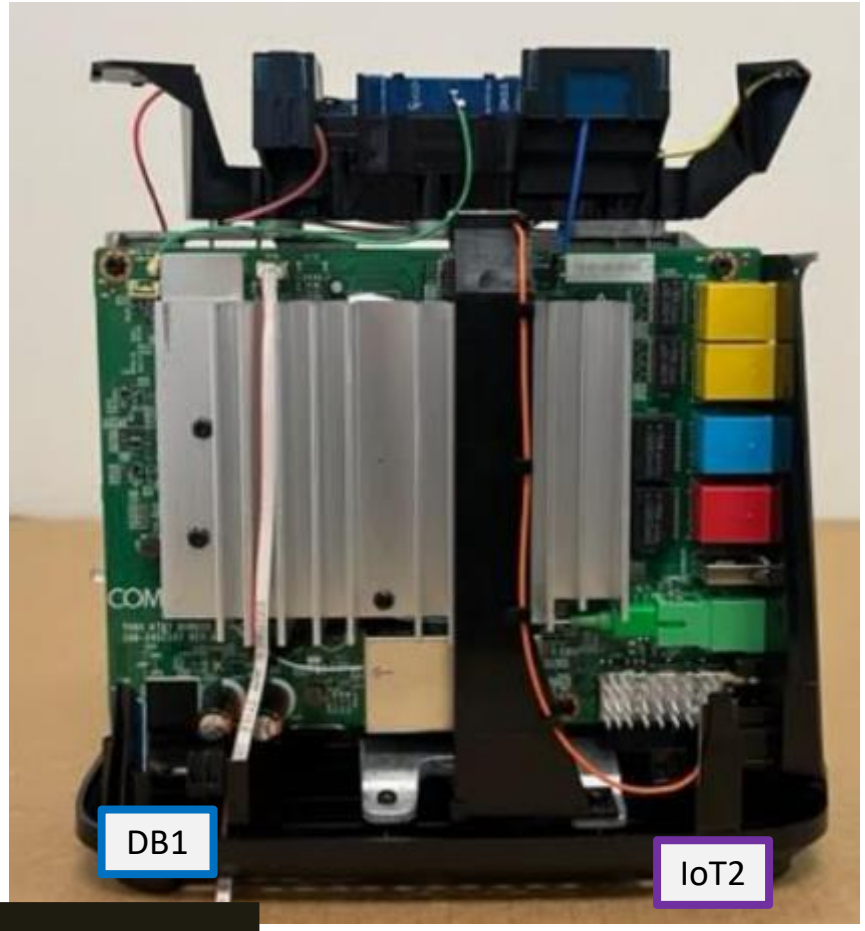
Heat Sink and PCBA





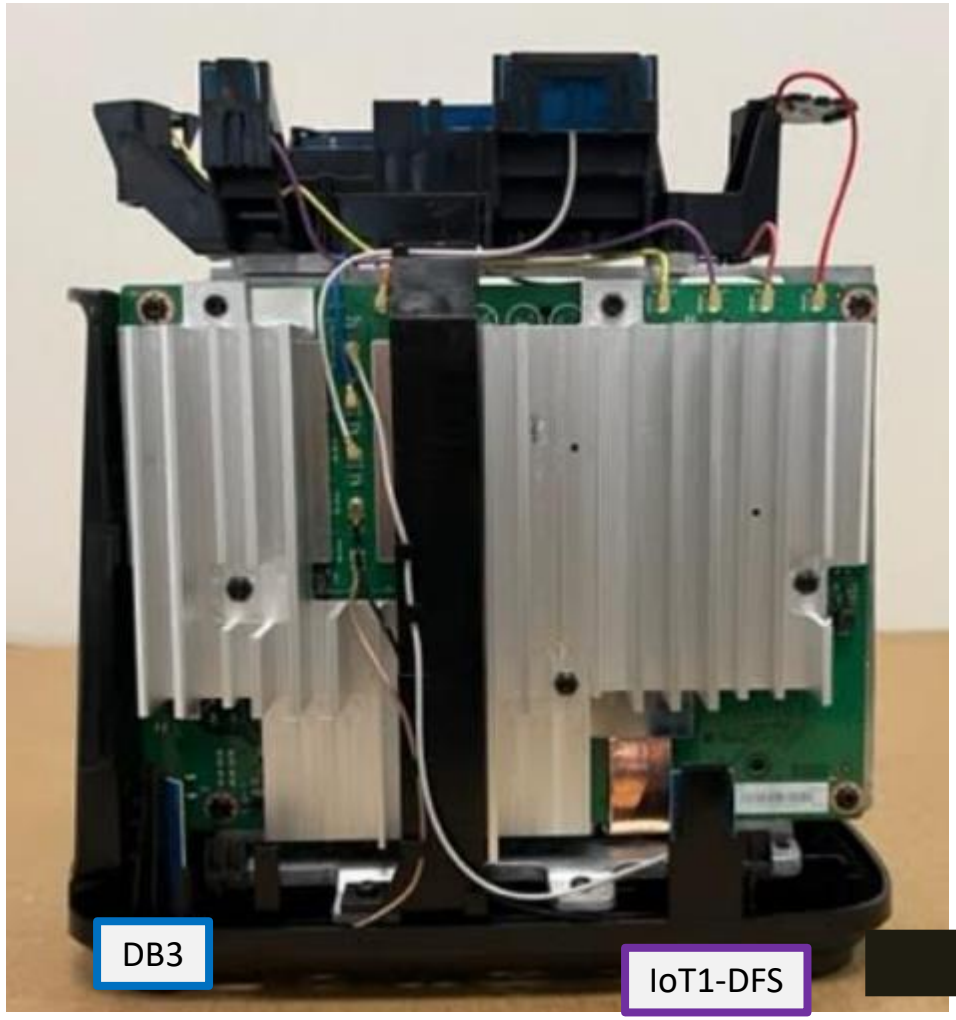


Heat Sink and PCBA



Front

Front

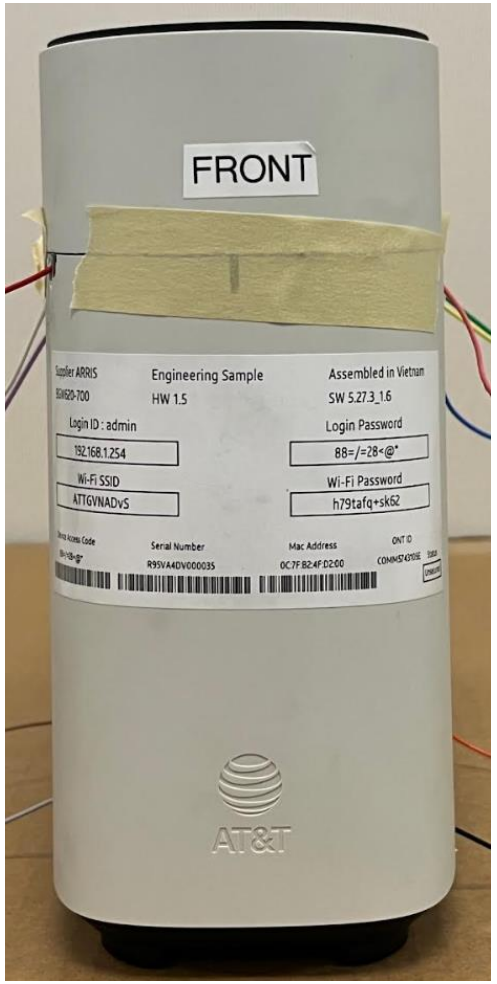


Front

Antenna with an enclosure

Front

The antennas were tested in full in Enclosure



Z-direction

Cable lengths and Antenna Orientation

Antenna	Total Cable Length	Orientation	Cable Color
DB1	273 mm	V	Black
DB2	137 mm	H	Blue
DB3	180 mm	V	Brown
DB4	137 mm	H	White
6G1	98 mm	H pol omni	Red
6G2	180 mm	H	Yellow
6G3	120 mm	V	Pink
6G4	160 mm	V	Purple
IoT1_DFS	208 mm	V	Gray
IoT2	252 mm	V	Orange
GNSS	127 mm	H	Green

V = vertical
H = horizontal

Cable lengths will be updated based on cable routing

DB Antennas Peak Gain and Efficiency

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB1	2400	4.779	6.631	65.29 %
	2450	4.195	6.175	63.39 %
	2500	4.786	6.883	61.70 %
	Average			63.46 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB2	2400	4.717	6.112	72.53 %
	2450	4.733	6.128	72.53 %
	2500	4.942	6.475	70.26 %
	Average			71.77 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB3	2400	4.450	6.249	66.08 %
	2450	4.725	6.512	66.26 %
	2500	4.112	5.837	67.22 %
	Average			66.52 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB4	2400	4.145	5.463	73.83 %
	2450	4.618	5.942	73.72 %
	2500	5.103	6.467	73.03 %
	Average			73.53 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB1	5150	4.404	6.531	61.27 %
	5250	4.182	6.383	60.25 %
	5350	4.423	6.478	62.30 %
	5500	4.622	6.728	61.57 %
	5725	4.370	6.585	60.05 %
	5825	4.306	6.480	60.62 %
	Average			61.01 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB2	5150	3.813	5.278	71.37 %
	5250	3.706	5.246	70.14 %
	5350	3.757	5.254	70.84 %
	5500	3.753	5.226	71.22 %
	5725	5.068	6.534	71.36 %
	5825	5.262	6.765	70.73 %
	Average			70.94 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB3	5150	4.401	6.526	61.30 %
	5250	4.812	6.708	64.62 %
	5350	4.663	6.277	68.95 %
	5500	4.814	6.367	69.93 %
	5725	4.978	6.692	67.38 %
	5825	5.217	6.993	66.43 %
	Average			66.44 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB4	5150	5.394	6.932	70.19 %
	5250	4.573	6.207	68.65 %
	5350	4.551	6.017	71.36 %
	5500	4.446	5.907	71.43 %
	5725	4.859	6.379	70.47 %
	5825	4.932	6.461	70.32 %
	Average			70.40 %

6 GHz Antenna Peak Gain and Efficiency

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
6G1	5925	3.230	4.875	68.46 %
	6300	2.848	4.538	67.75 %
	6500	3.006	4.743	67.03 %
	6800	2.910	4.657	66.88 %
	7125	2.820	4.598	66.40 %
	Average			67.30 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
6G2	5925	3.516	5.083	69.72 %
	6300	3.609	5.030	72.09 %
	6500	4.059	5.495	71.85 %
	6800	4.379	5.789	72.29 %
	7125	4.131	5.635	70.73 %
	Average			71.34 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
6G3	5925	4.734	6.278	70.09 %
	6300	5.303	6.737	71.87 %
	6500	5.039	6.535	70.87 %
	6800	4.827	6.274	71.67 %
	7125	5.833	7.432	69.19 %
	Average			70.74 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
6G4	5925	5.037	6.497	71.44 %
	6300	5.050	6.522	71.25 %
	6500	4.515	6.030	70.54 %
	6800	5.377	7.010	68.65 %
	7125	5.232	6.846	68.97 %
	Average			70.17 %

GNSS, DFS, and IOTs Antennas Peak Gain and Efficiency

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
GNSS	1575	4.219	5.586	72.99 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
IoT1	2400	4.716	6.386	68.07 %
	2450	4.592	6.383	66.20 %
	2500	4.480	6.320	65.47 %
	Average			66.58 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
IoT2	2400	3.765	5.306	70.13 %
	2450	3.578	5.314	67.06 %
	2500	3.457	5.375	64.30 %
	Average			67.16 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DFS 5GHz	5150	5.674	7.805	61.23 %
	5250	5.559	7.506	63.87 %
	5350	5.162	7.319	60.85 %
	5500	4.787	6.943	60.87 %
	5725	4.916	6.958	62.49 %
	5825	4.220	6.315	61.73 %
	Average			61.84 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DFS 6 GHz	5925	4.424	6.384	63.68 %
	6300	5.180	7.335	60.89 %
	6500	4.457	6.610	60.91 %
	6800	5.444	7.437	63.19 %
	7125	5.270	7.321	62.35 %
	Average			62.20 %

DB 2.45 GHz Horizontal and Vertical Correlated directional Gain

Worst Case

	Degree		Gain (dBi)				Correlated Gain (dBi) - H-Pol
Frequency (MHz)	Theta	Phi	DB1	DB2	DB3	DB4	
2400	82	296	-16.26	0.26	-1.79	0.35	3.63
2450	83	298	-11.08	0.91	-2.59	1.21	4.30
2500	84	300	-12.61	1.83	-10.26	2.86	3.99

	Degree		Gain (dBi)				Correlated Gain (dBi)-V-Pol
Frequency (MHz)	Theta	Phi	DB1	DB2	DB3	DB4	
2400	27	23	-4.56	0.85	-6.24	0.95	4.34
2450	51	27	1.37	-0.70	-5.66	-2.78	4.46
2500	53	28	-0.35	-0.35	-3.64	-1.10	4.76

DB 2.45 GHz Horizontal and Vertical Uncorrelated directional Gain

Worst Case

	Degree		Gain (dBi)				UnCorrelated Gain (dBi) - H-Pol
Frequency (MHz)	Theta	Phi	DB1	DB2	DB3	DB4	
2400	118	100	-19.74	4.33	-8.11	-3.98	-0.87
2450	114	285	-15.58	-3.31	-5.51	4.44	-0.51
2500	114	286	-8.30	-4.28	-8.79	4.86	-0.33

	Degree		Gain (dBi)				UnCorrelated Gain (dBi)-V-Pol
Frequency (MHz)	Theta	Phi	DB1	DB2	DB3	DB4	
2400	106	82	4.13	-8.48	-1.28	-14.88	-0.57
2450	88	118	3.98	-12.27	-1.55	-11.26	-0.79
2500	108	297	-0.96	-14.67	2.74	-4.27	-1.12

5 GHz Horizontal and Vertical Correlated directional Gain

Worst Case

	Degree		Gain (dBi)				Correlated Gain (dBi) - H-Pol
Frequency (MHz)	Theta	Phi	DB1	DB2	DB3	DB4	
5150	6	93	-10.18	3.45	-3.25	4.05	6.19
5250	5	253	-9.51	3.05	-5.46	0.81	4.57
5350	8	91	-8.61	2.20	-5.29	2.18	4.83
5500	31	71	-4.69	1.96	-8.35	2.37	4.94
5725	0	92	-7.55	2.86	-4.77	2.34	5.33
5825	84	257	-10.57	1.04	-6.12	4.85	5.26

	Degree		Gain (dBi)				Correlated Gain (dBi)-V-Pol
Frequency (MHz)	Theta	Phi	DB1	DB2	DB3	DB4	
5150	29	4	-3.50	1.83	-3.66	3.27	6.06
5250	32	7	-1.37	1.38	-2.57	2.97	6.39
5350	34	354	-1.16	1.08	-5.98	3.08	5.88
5500	35	8	-1.66	-0.46	-3.28	2.45	5.54
5725	1	1	-6.10	3.05	-5.83	2.44	5.46
5825	91	6	2.95	-3.82	-2.98	-2.54	4.87

5 GHz Horizontal and Vertical Uncorrelated directional Gain

Worst Case

	Degree		Gain (dBi)				UnCorrelated Gain (dBi) - H-Pol
Frequency (MHz)	Theta	Phi	DB1	DB2	DB3	DB4	
5150	6	100	-12.24	3.51	-3.72	4.34	1.34
5250	13	103	-16.21	1.46	-10.82	3.53	-0.27
5350	12	97	-9.61	1.50	-8.68	3.70	0.00
5500	83	260	-19.21	2.48	-8.19	3.52	0.19
5725	85	258	-12.59	0.79	-6.21	4.83	0.55
5825	85	256	-12.69	1.13	-5.96	4.91	0.70

	Degree		Gain (dBi)				UnCorrelated Gain (dBi)-V-Pol
Frequency (MHz)	Theta	Phi	DB1	DB2	DB3	DB4	
5150	0	3	-10.10	2.03	-7.64	4.44	0.65
5250	8	10	-9.12	3.08	-13.38	3.97	0.70
5350	33	354	-1.04	1.28	-6.56	3.04	0.38
5500	22	359	-3.32	1.10	-9.11	3.85	0.31
5725	1	356	-5.74	3.09	-6.87	2.54	0.32
5825	86	350	4.16	-7.45	-6.25	-1.25	-0.25

6 GHz Horizontal and Vertical Correlated directional Gain

Worst Case

	Degree		Gain (dBi)				Correlated Gain (dBi) - H-Pol
Frequency (MHz)	Theta	Phi	6G1	6G2	6G3	6G4	
5925	87	330	1.74	2.60	-8.54	-13.22	3.98
6300	93	330	1.71	2.72	-10.08	-14.12	3.80
6500	85	320	1.92	2.68	-8.95	-10.54	4.25
6800	94	311	1.11	3.87	-8.00	-9.29	4.71
7125	94	324	1.35	3.96	-10.54	-10.86	4.43

	Degree		Gain (dBi)				Correlated Gain (dBi)-V-Pol
Frequency (MHz)	Theta	Phi	6G1	6G2	6G3	6G4	
5925	86	18	-8.37	-7.60	2.96	4.75	5.87
6300	90	10	-10.26	-24.42	5.15	4.09	5.52
6500	91	10	-11.80	-15.60	4.54	4.37	5.49
6800	96	20	-15.62	-6.58	3.52	3.93	5.36
7125	81	81	-7.94	-4.31	2.28	3.68	5.66

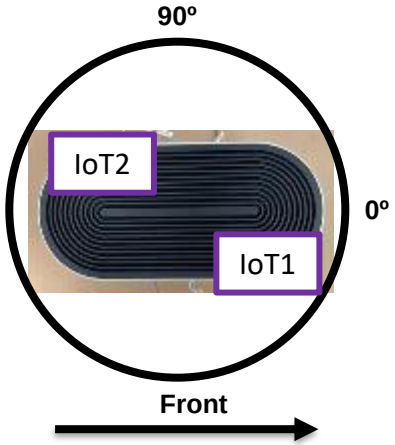
6 GHz Horizontal and Vertical Uncorrelated directional Gain

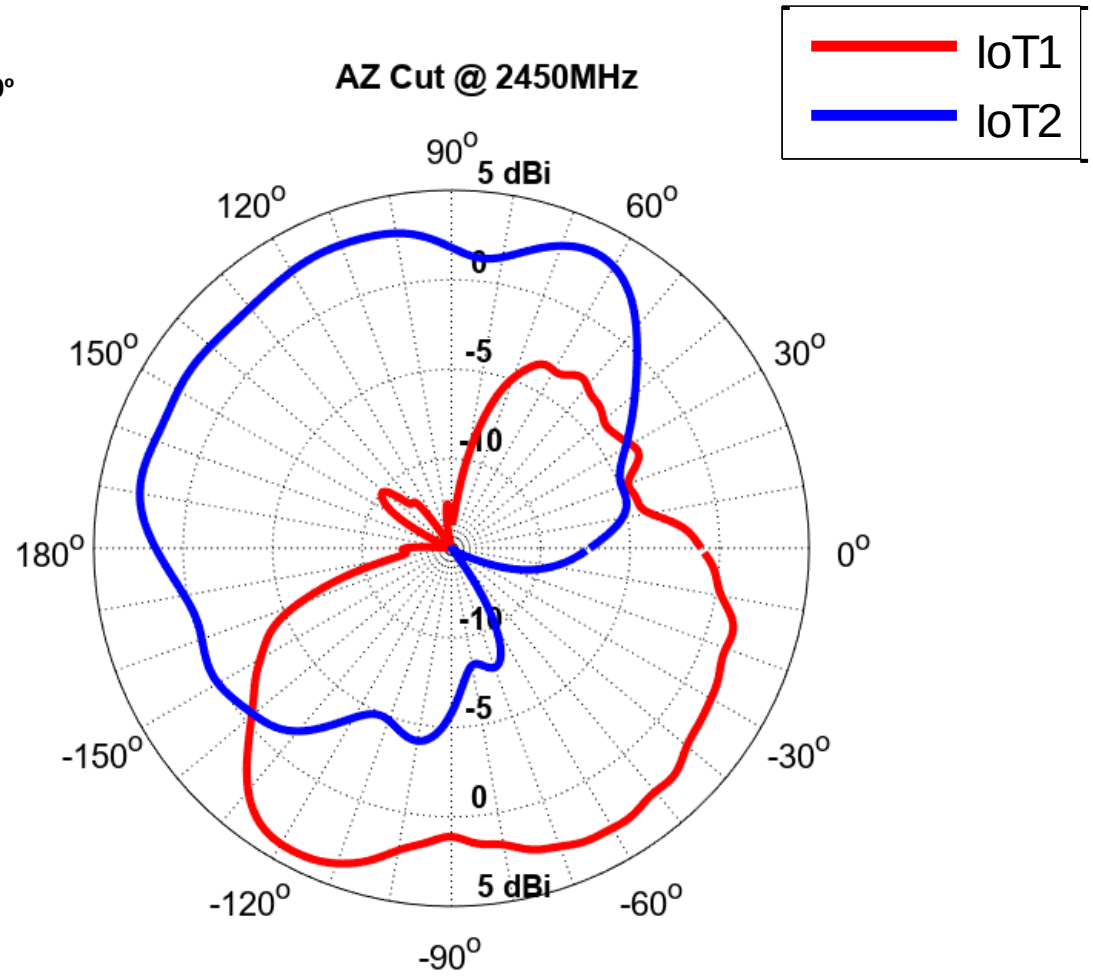
Worst Case

	Degree		Gain (dBi)				UnCorrelated Gain (dBi) - H-Pol
Frequency (MHz)	Theta	Phi	6G1	6G2	6G3	6G4	
5925	86	157	2.71	2.24	-19.68	-19.84	-0.51
6300	93	330	1.71	2.72	-10.08	-14.12	-0.59
6500	85	321	1.97	2.67	-9.16	-10.80	-0.42
6800	93	311	1.10	3.90	-7.53	-10.11	0.02
7125	91	325	1.90	4.08	-10.82	-21.01	0.21

	Degree		Gain (dBi)				UnCorrelated Gain (dBi)-V-Pol
Frequency (MHz)	Theta	Phi	6G1	6G2	6G3	6G4	
5925	87	18	-8.51	-8.26	2.94	4.90	1.26
6300	90	9	-10.33	-28.37	5.03	4.29	1.74
6500	91	10	-11.80	-15.60	4.54	4.37	1.52
6800	96	22	-18.64	-7.21	3.73	3.99	1.03
7125	92	11	-21.43	-15.31	3.94	5.09	1.57

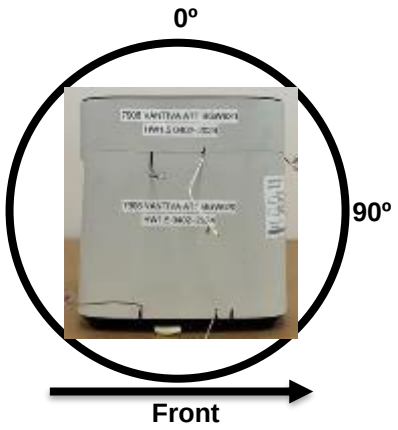
Azimuth Cut - Power Sum
System Coverage – IoT Antennas

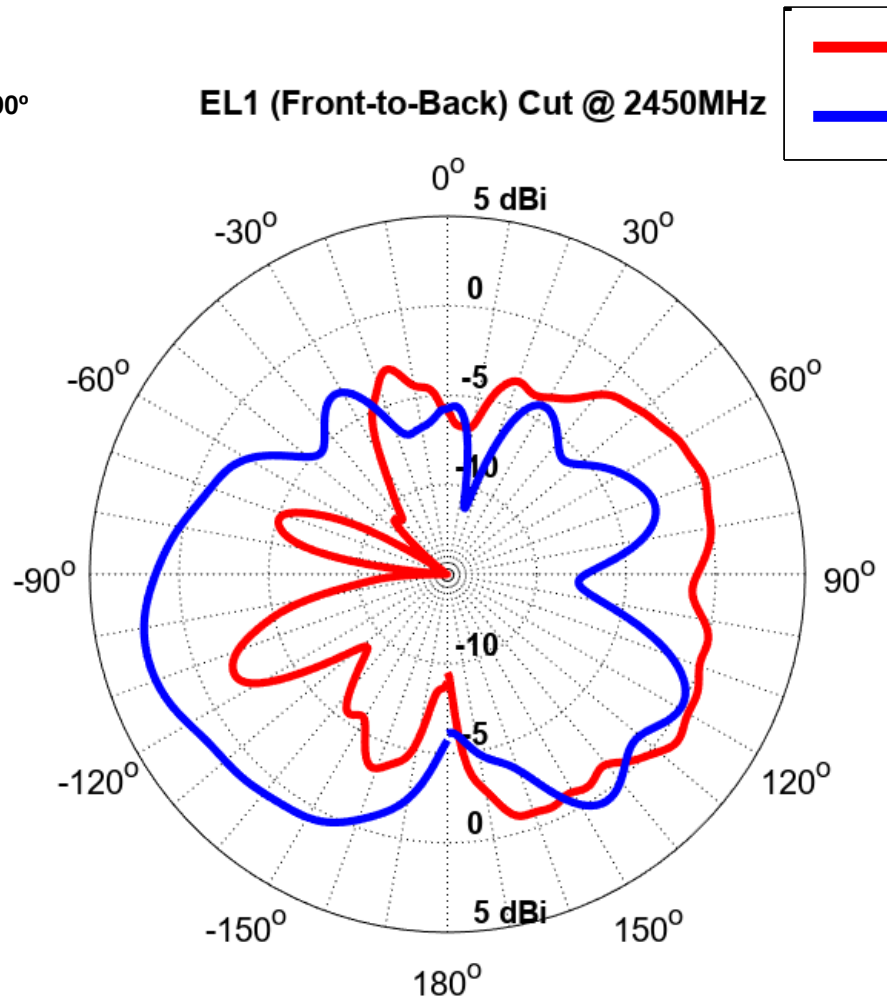




2.45 GHz

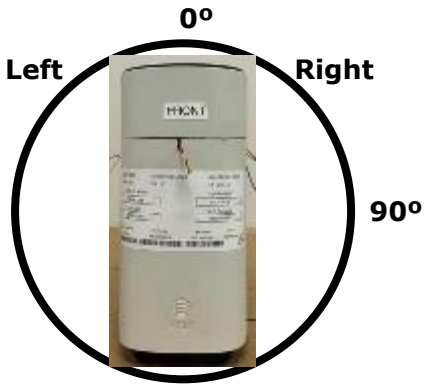
Elevation (Front to Back) Cut - Power Sum System Coverage – IoT Antennas

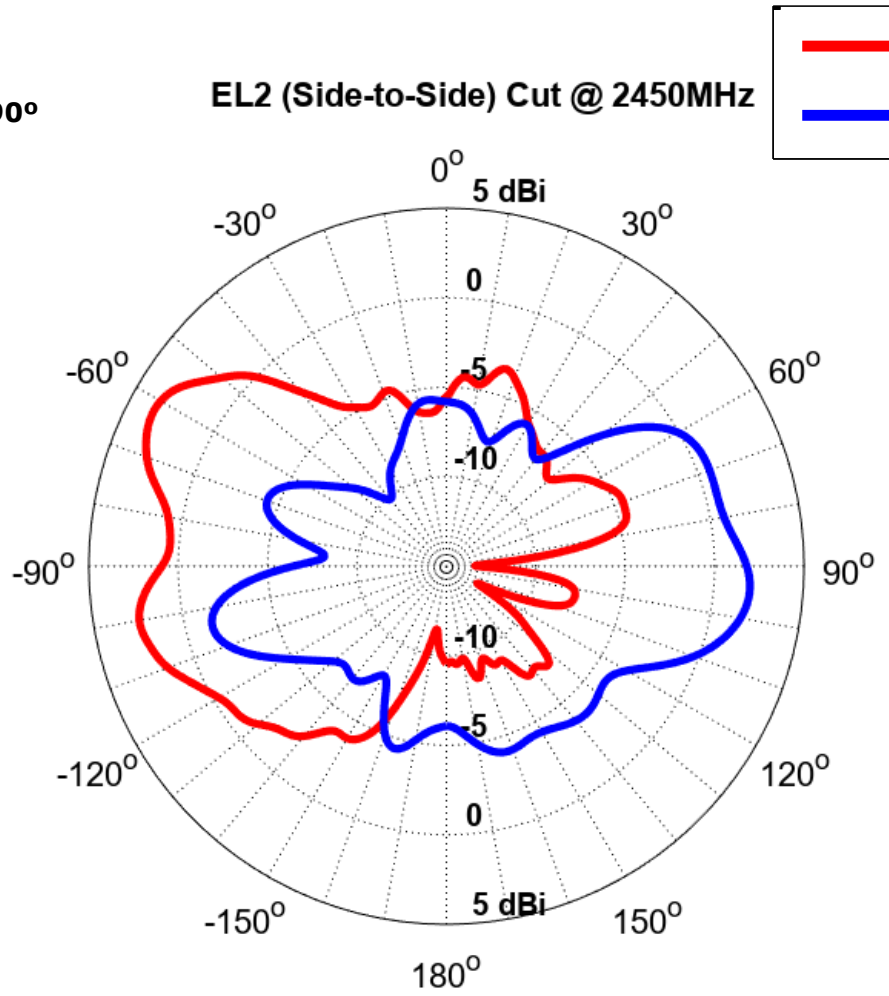




2.45 GHz

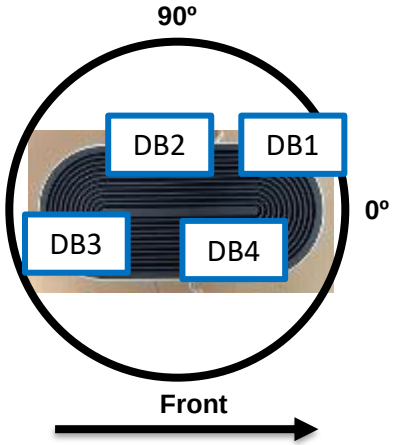
Elevation (Side to Side) Cut - Power Sum System Coverage – IoT Antennas

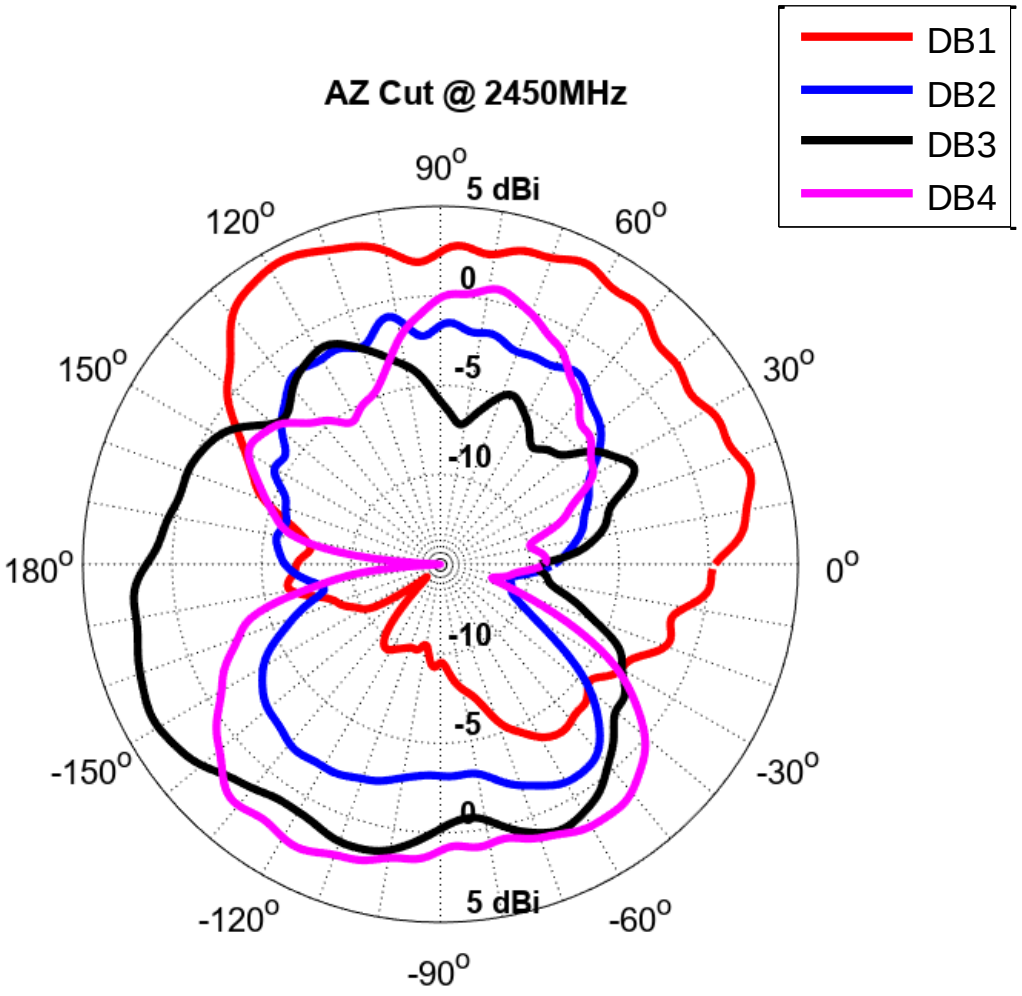




2.45 GHz

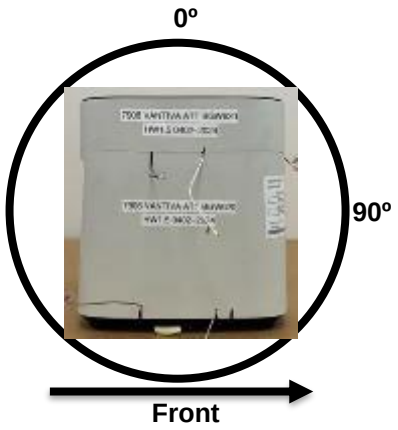
Azimuth Cut - Power Sum
System Coverage – DB Antennas

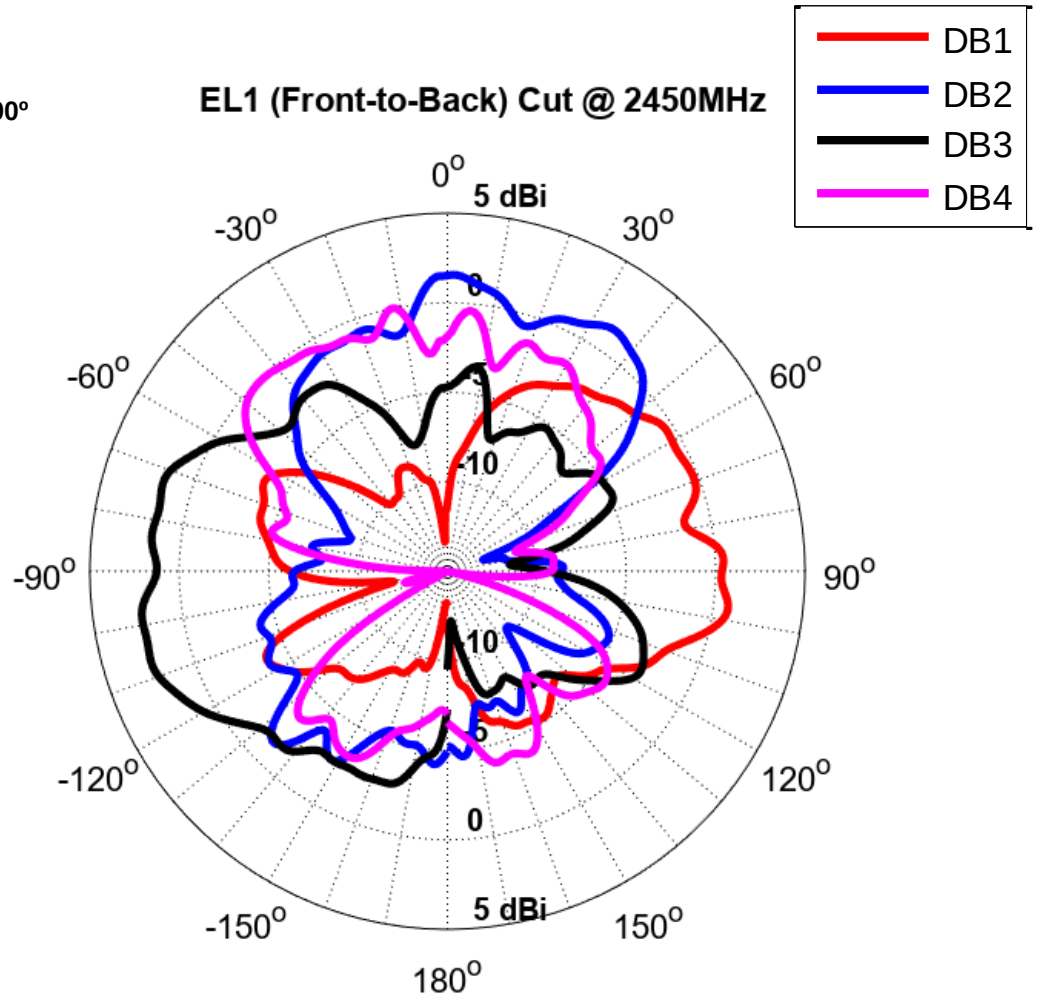




2.45 GHz

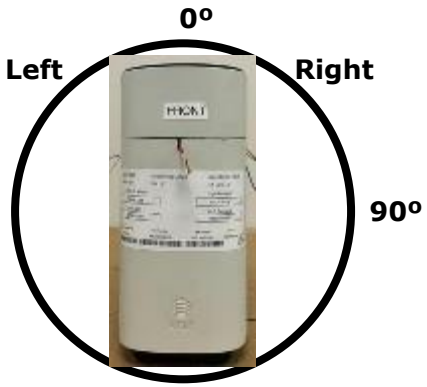
Elevation (Front to Back) Cut - Power Sum System Coverage – DB Antennas

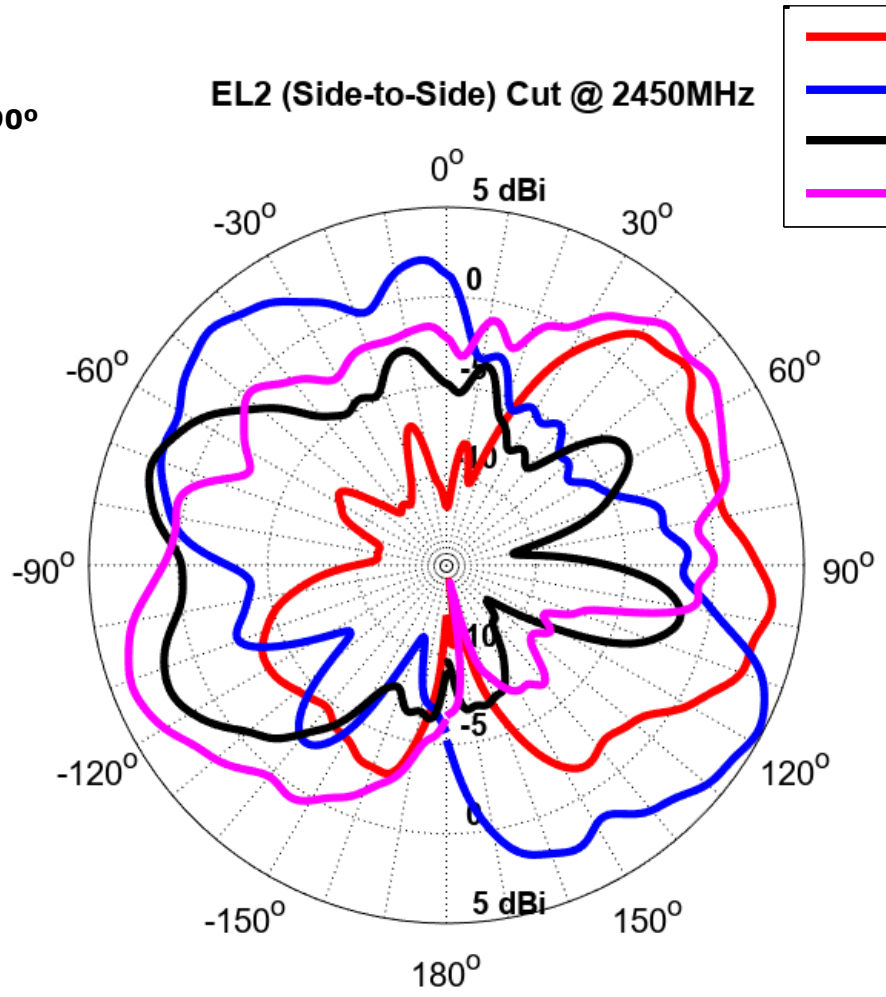




2.45 GHz

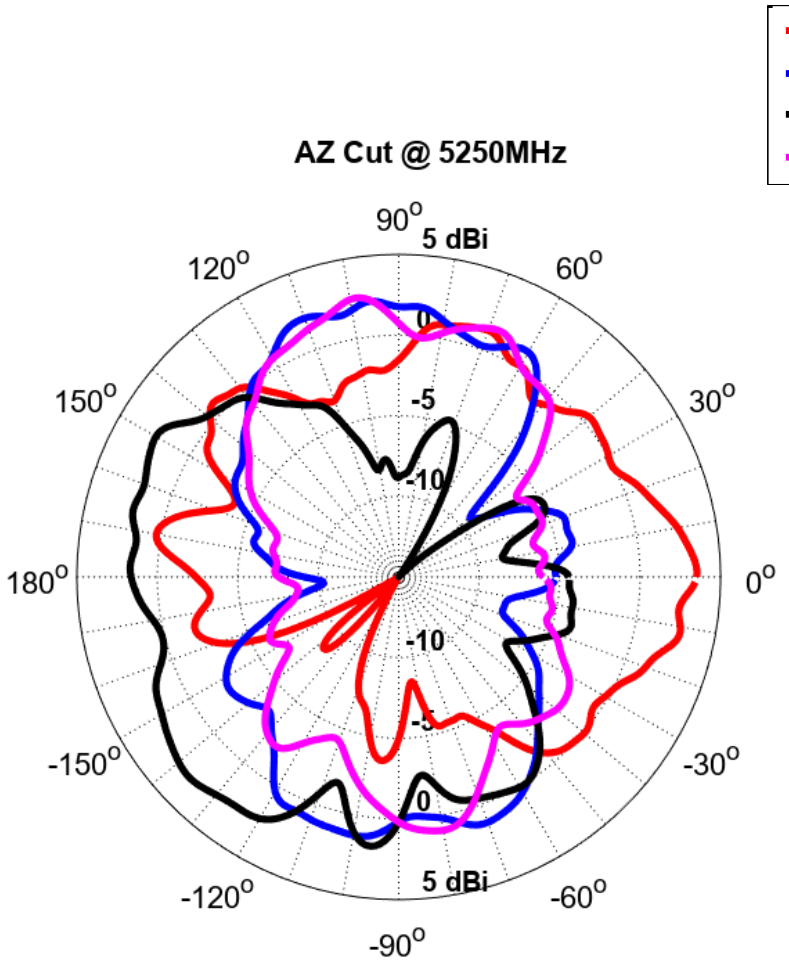
Elevation (Side to Side) Cut - Power Sum System Coverage – DB Antennas

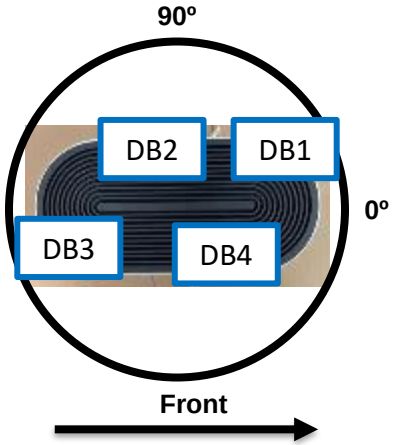


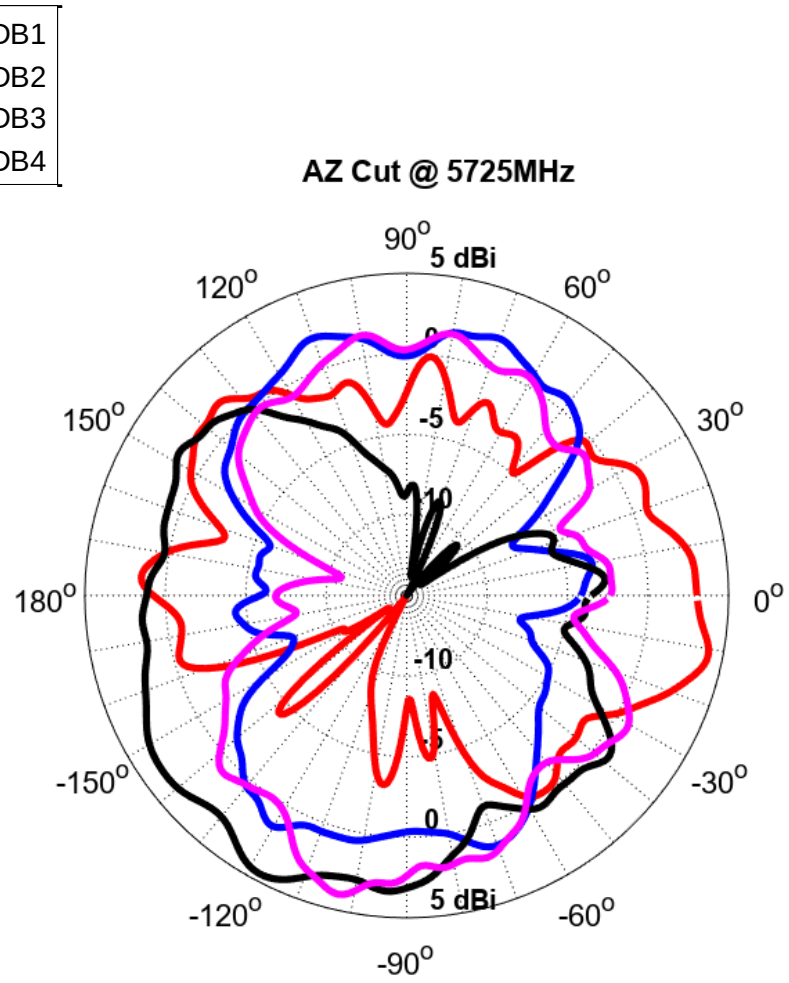


2.45 GHz

Azimuth Cut - Power Sum
System Coverage – DB Antennas



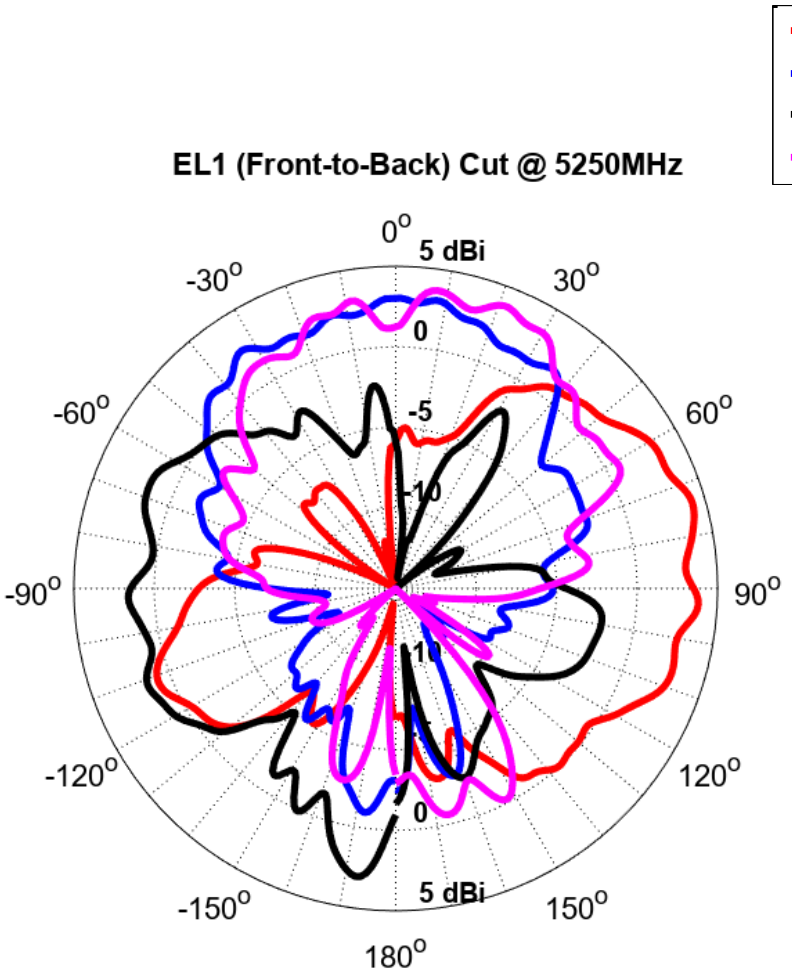




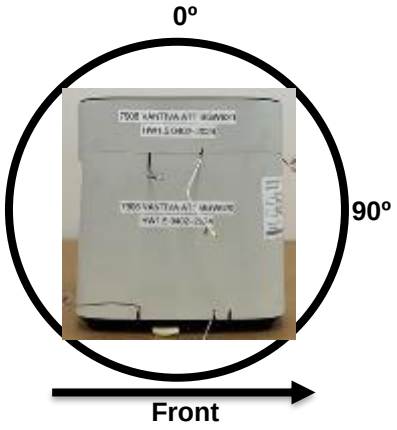
Dual Band – 5.25 GHz

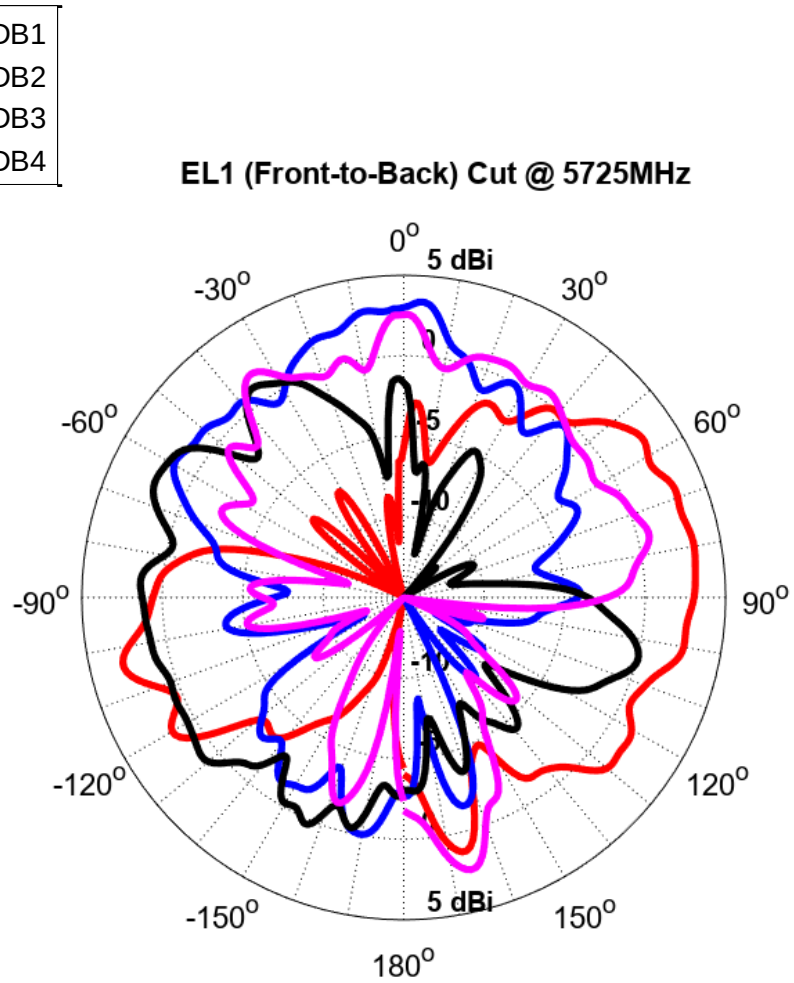
Dual Band – 5.725 GHz

Elevation (Front to Back) Cut - Power Sum System Coverage – DB Antennas



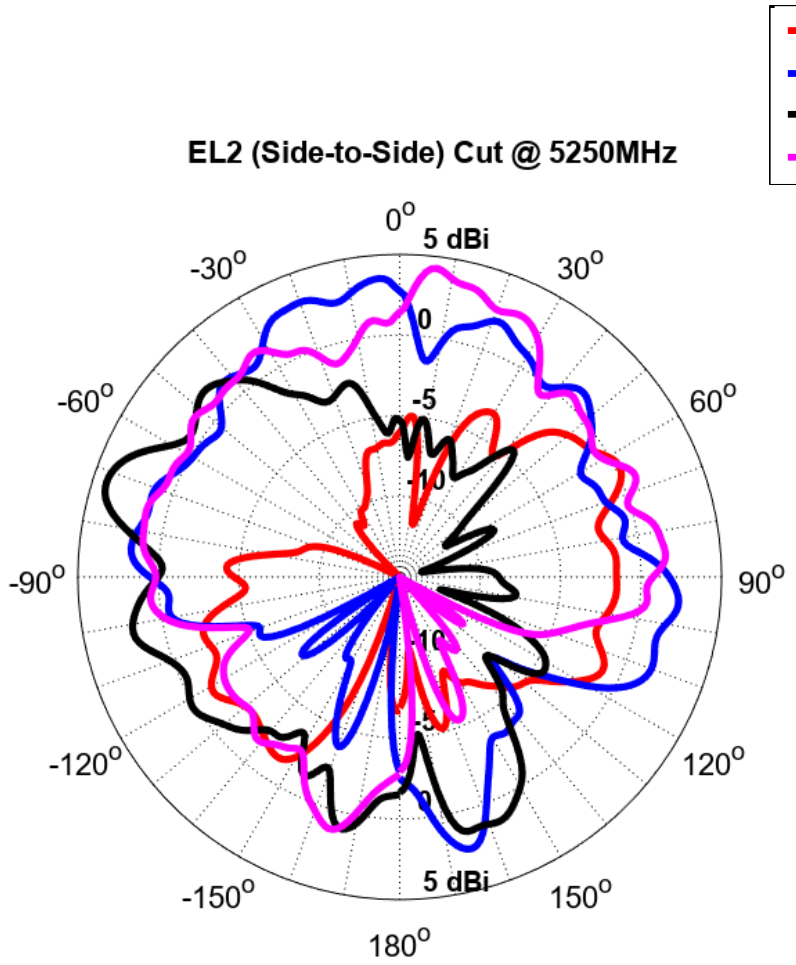
Dual Band – 5.25 GHz



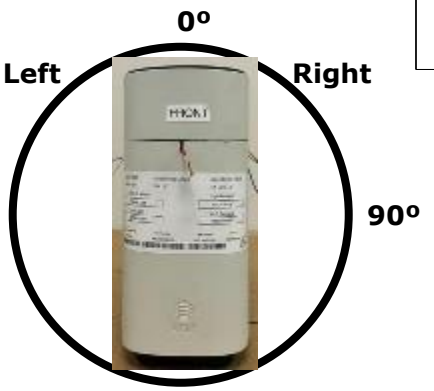


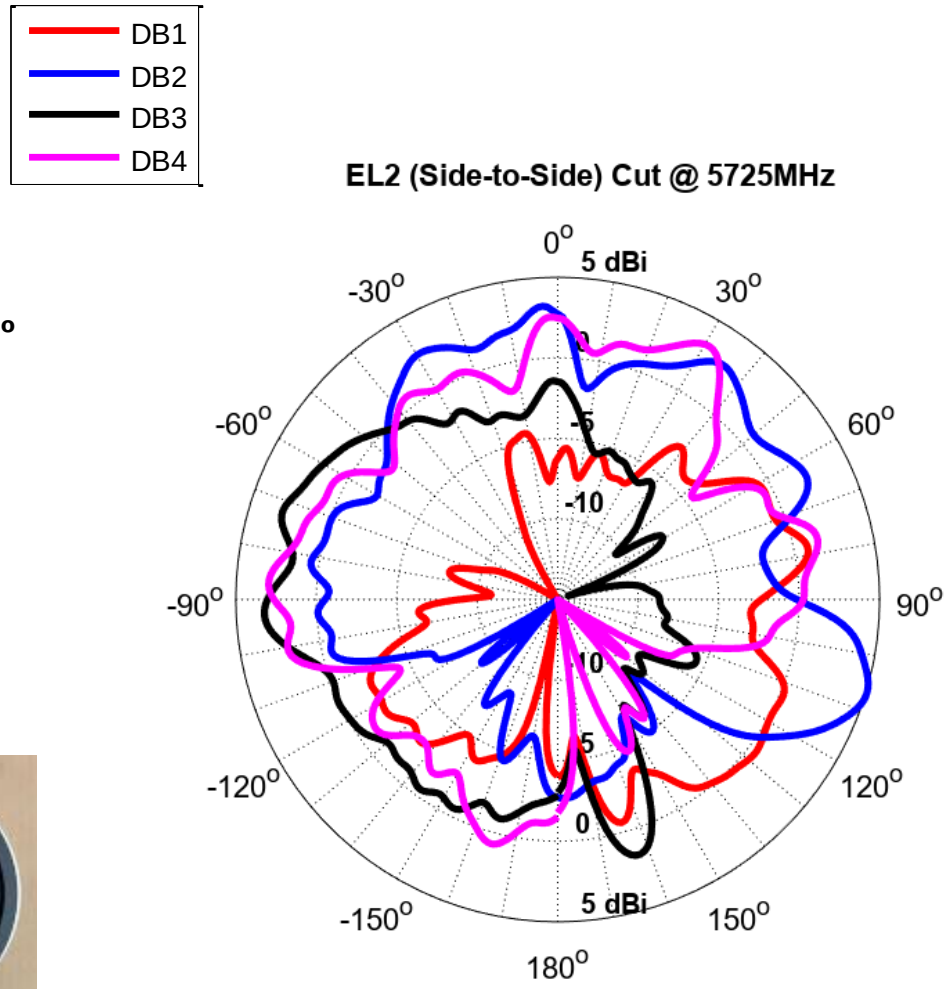
Dual Band – 5.725 GHz

Elevation (Side to Side) Cut - Power Sum System Coverage – DB Antennas



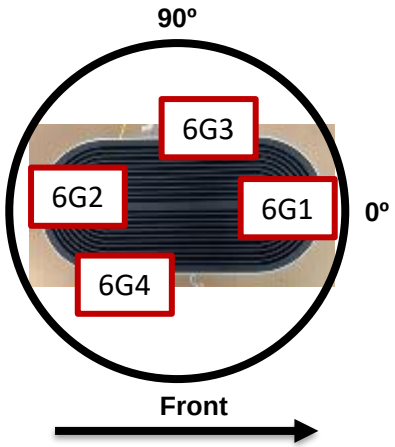
Dual Band – 5.25 GHz

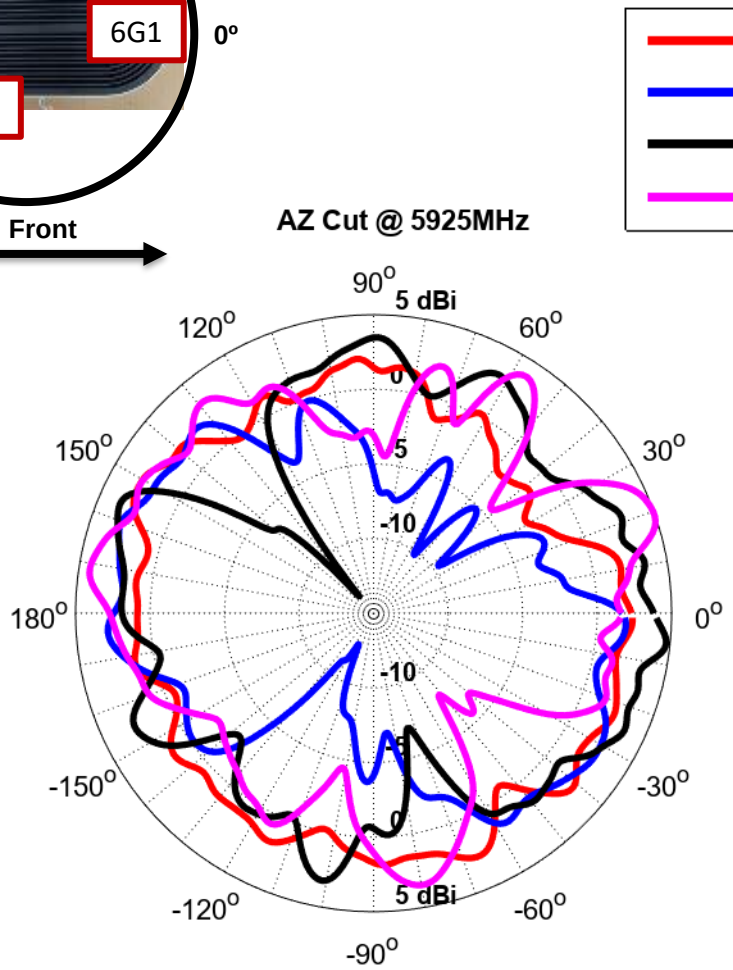




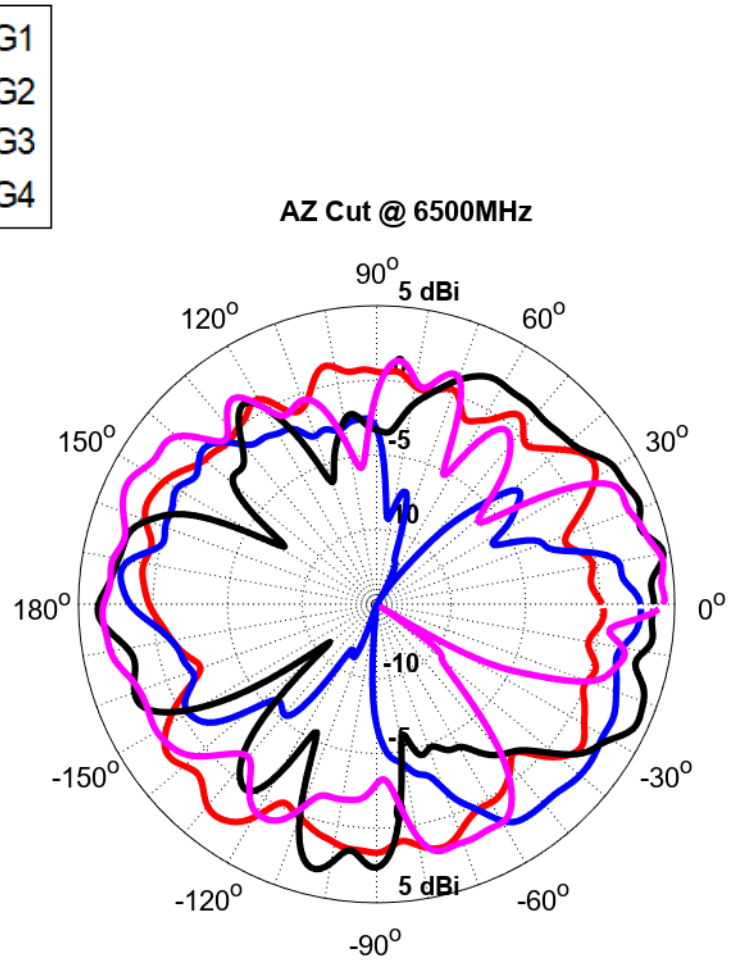
Dual Band – 5.725 GHz

Azimuth Cut - Power Sum
System Coverage – 6 GHz Antennas

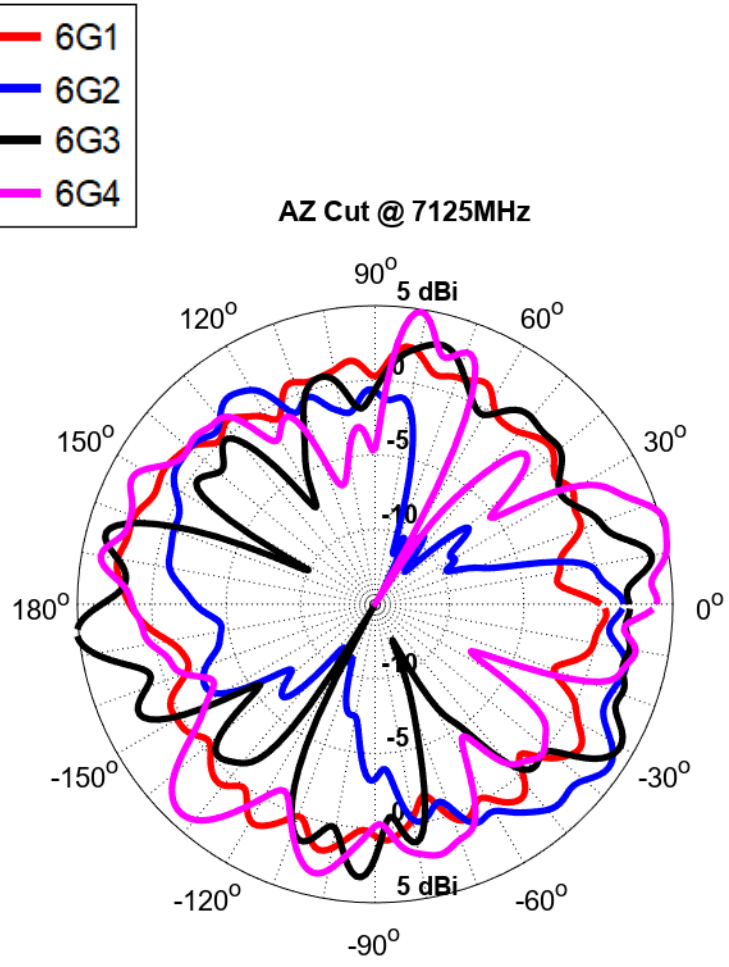




5.925 GHz

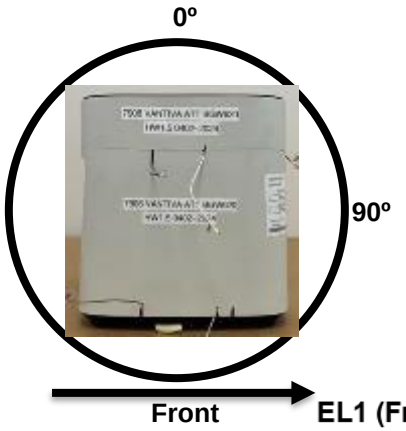


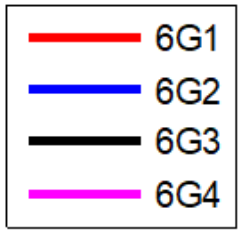
6.5 GHz



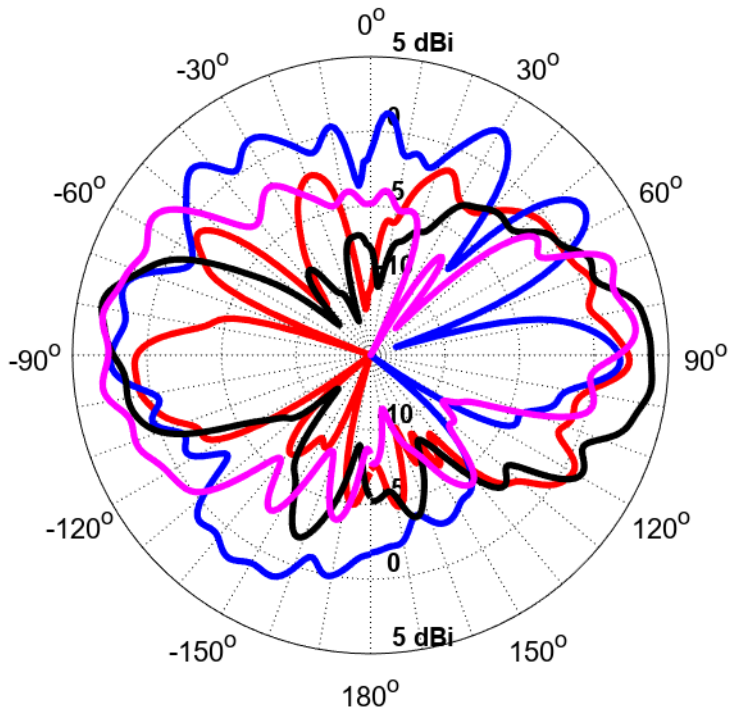
7.125 GHz

Elevation (Front to Back) Cut - Power Sum System Coverage – 6 GHz Antennas

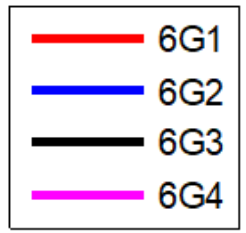




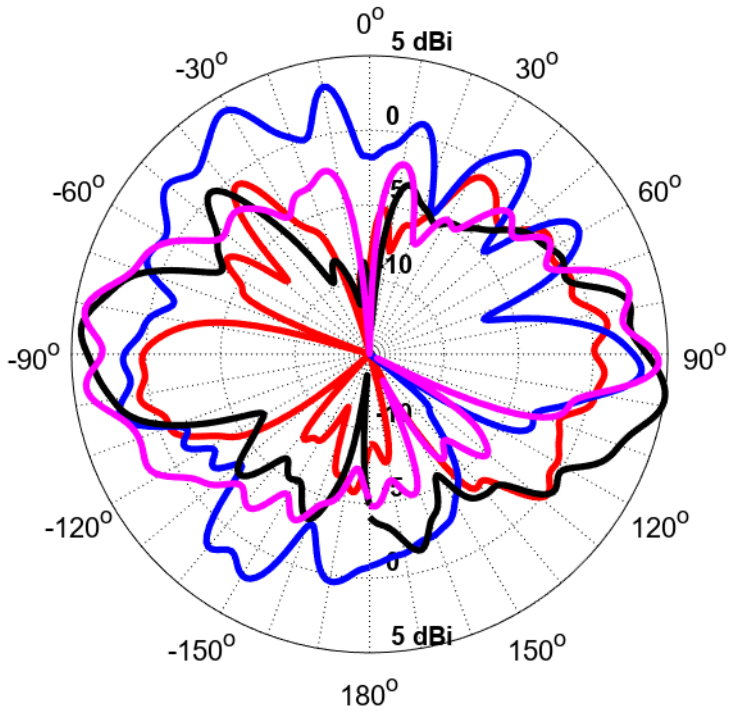
EL1 (Front-to-Back) Cut @ 5925MHz



5.925 GHz

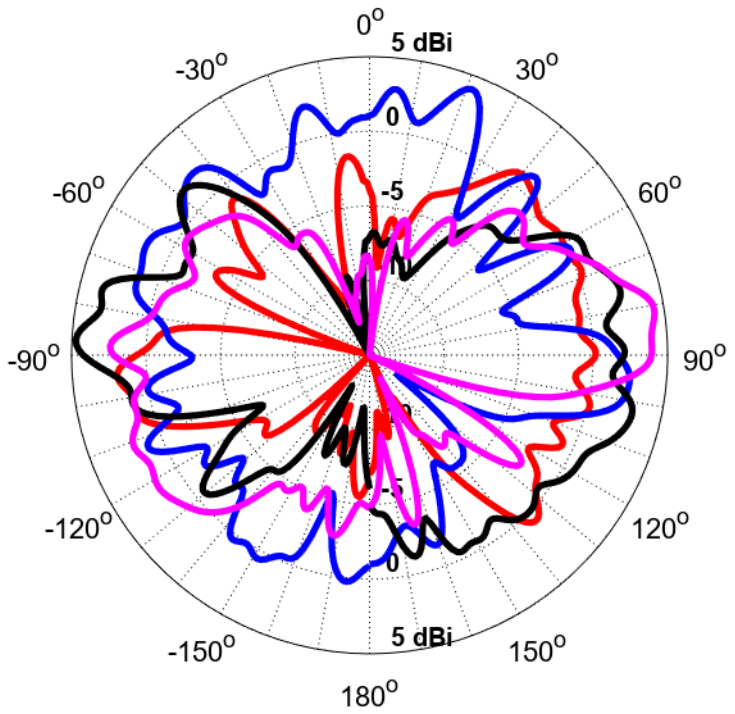


EL1 (Front-to-Back) Cut @ 6500MHz



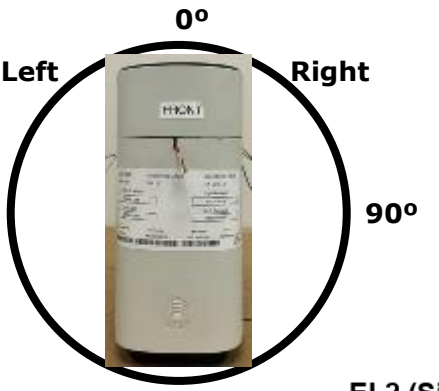
6.5 GHz

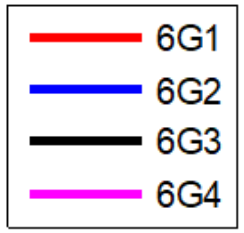
EL1 (Front-to-Back) Cut @ 7125MHz



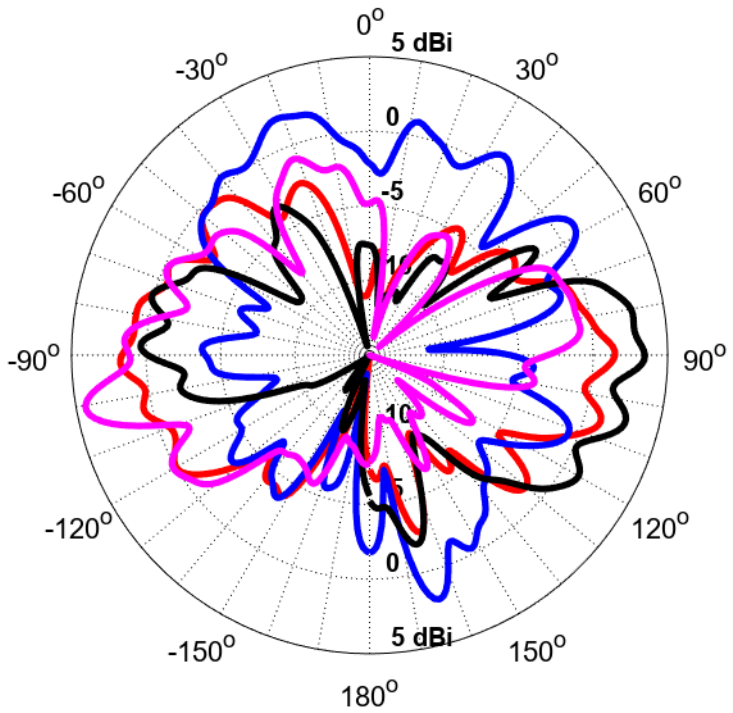
7.125 GHz

Elevation (Side to Side) Cut - Power Sum System Coverage – 6 GHz Antennas

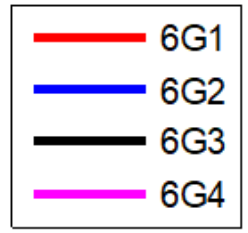




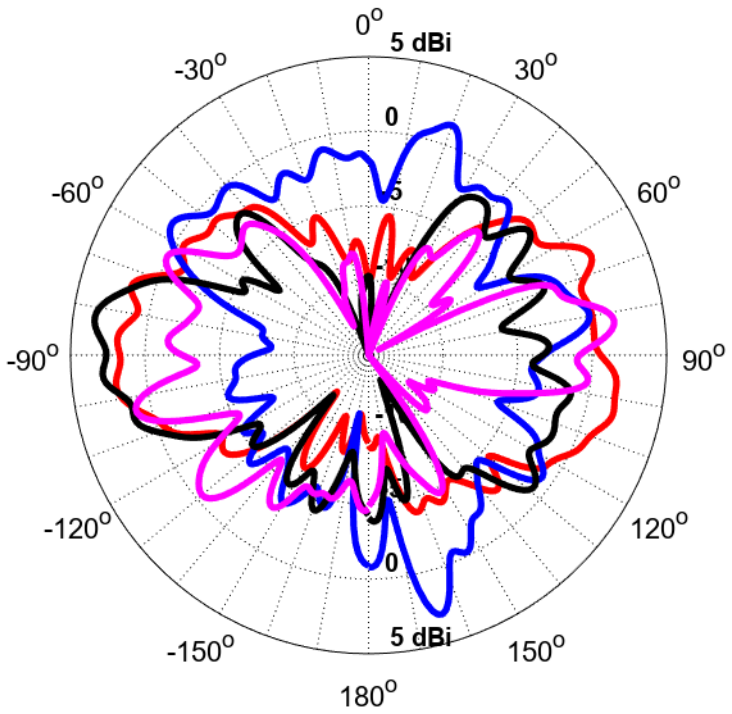
EL2 (Side-to-Side) Cut @ 5925MHz



5.925 GHz

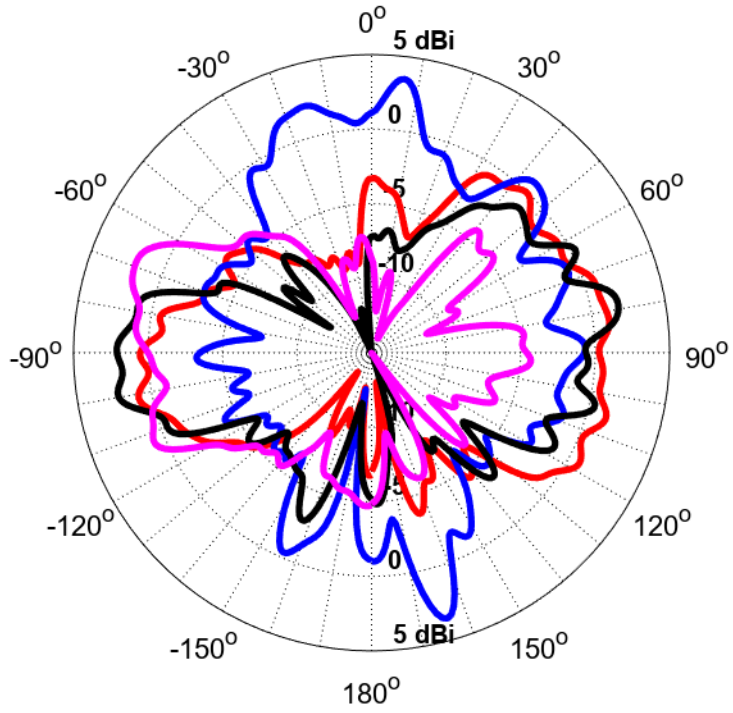


EL2 (Side-to-Side) Cut @ 6500MHz



6.5 GHz

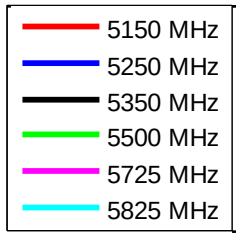
EL2 (Side-to-Side) Cut @ 7125MHz

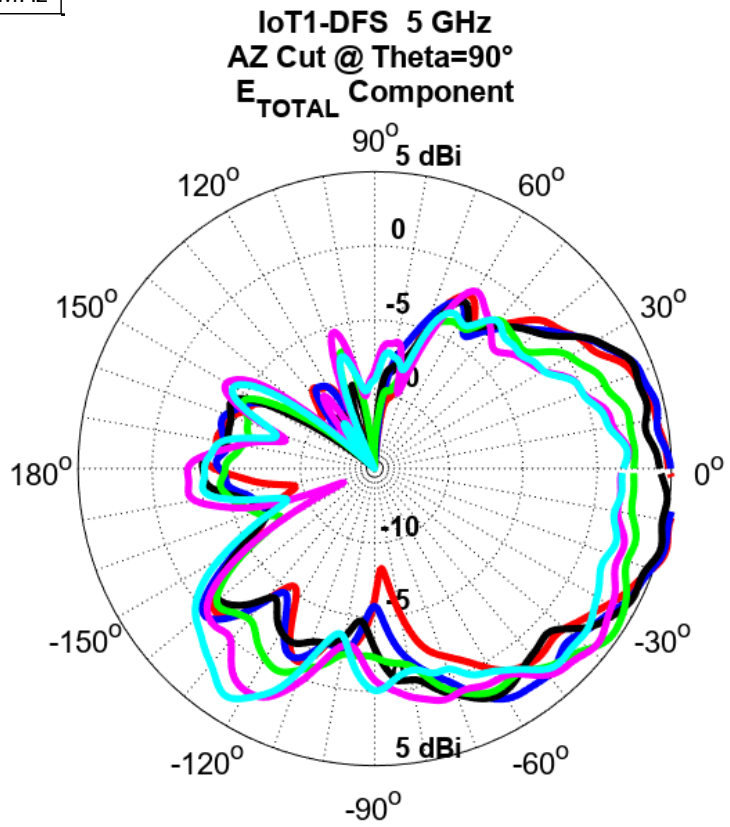


7.125 GHz

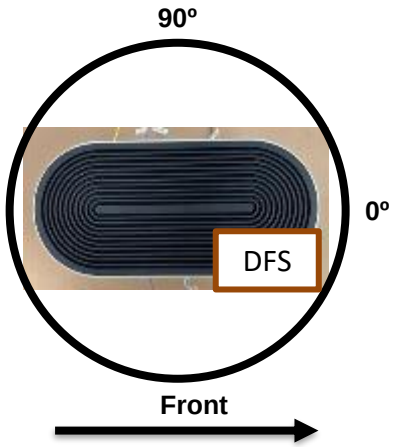
Azimuth Cut - Power Sum

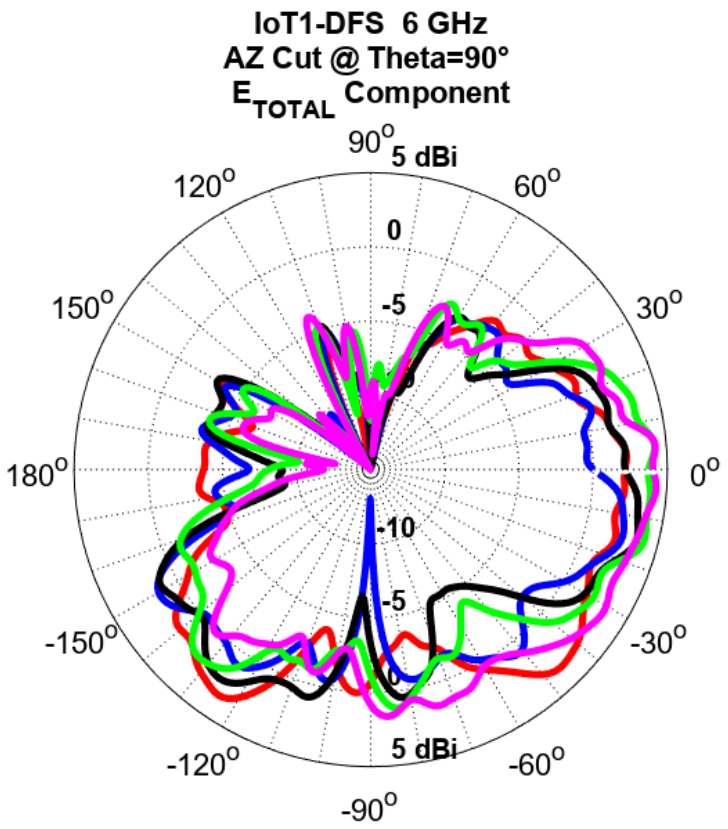
DFS Antenna

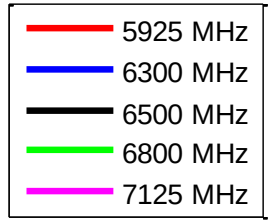




DFS-5 GHz





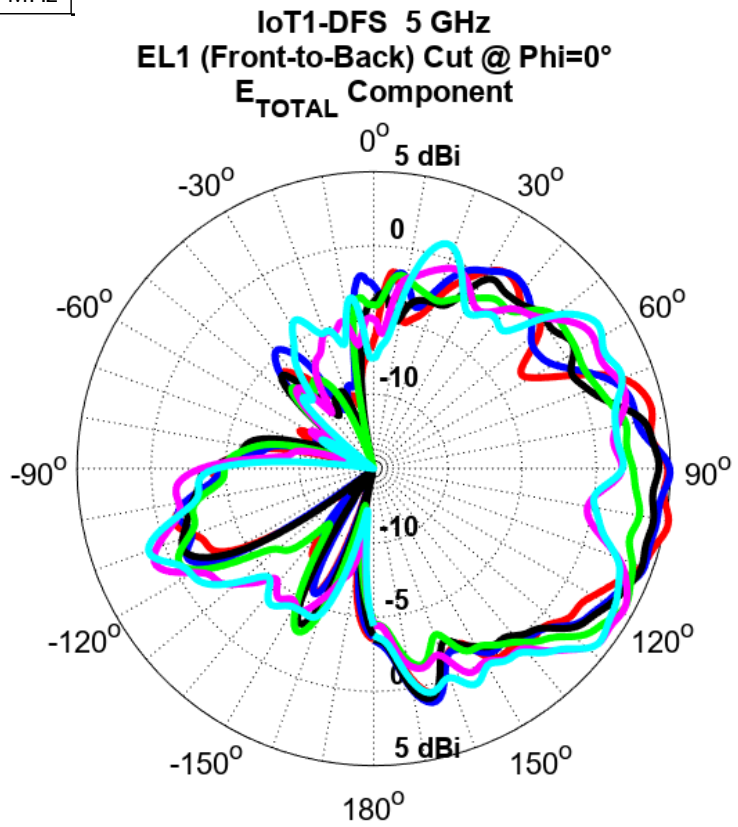


DFS-6 GHz

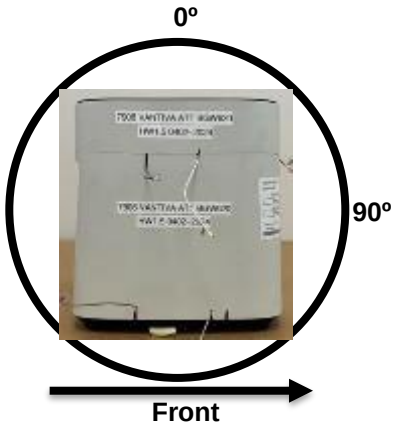
Elevation (Front to Back) Cut - Power Sum

DFS Antenna

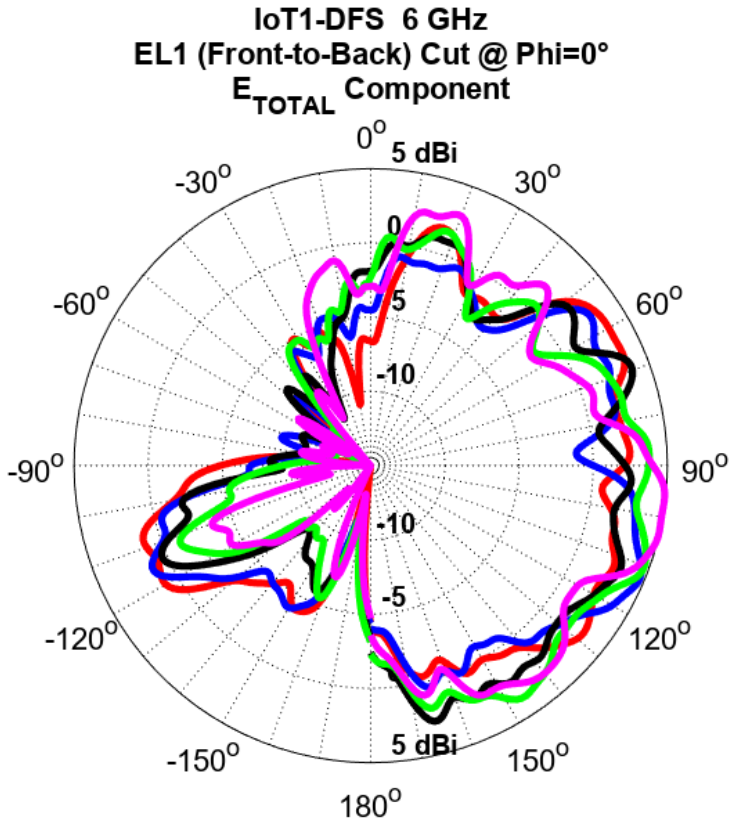
5150 MHz
5250 MHz
5350 MHz
5500 MHz
5725 MHz
5825 MHz



DFS-5 GHz



5925 MHz
6300 MHz
6500 MHz
6800 MHz
7125 MHz

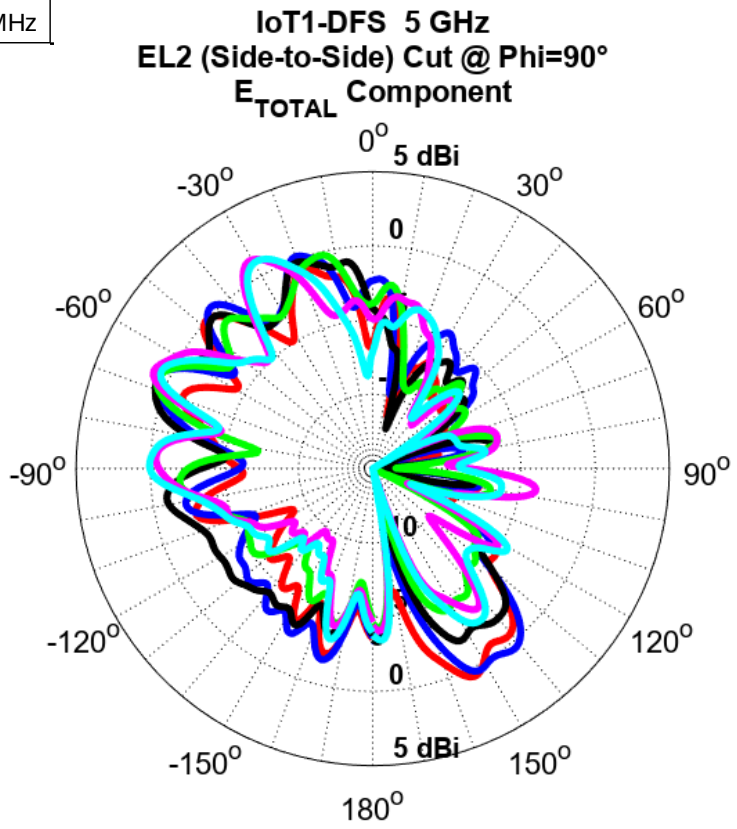


DFS-6 GHz

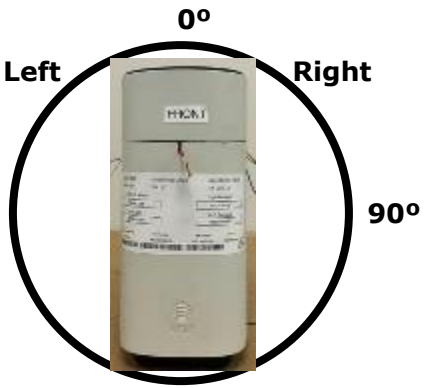
Elevation (Side to Side) Cut - Power Sum

DFS Antenna

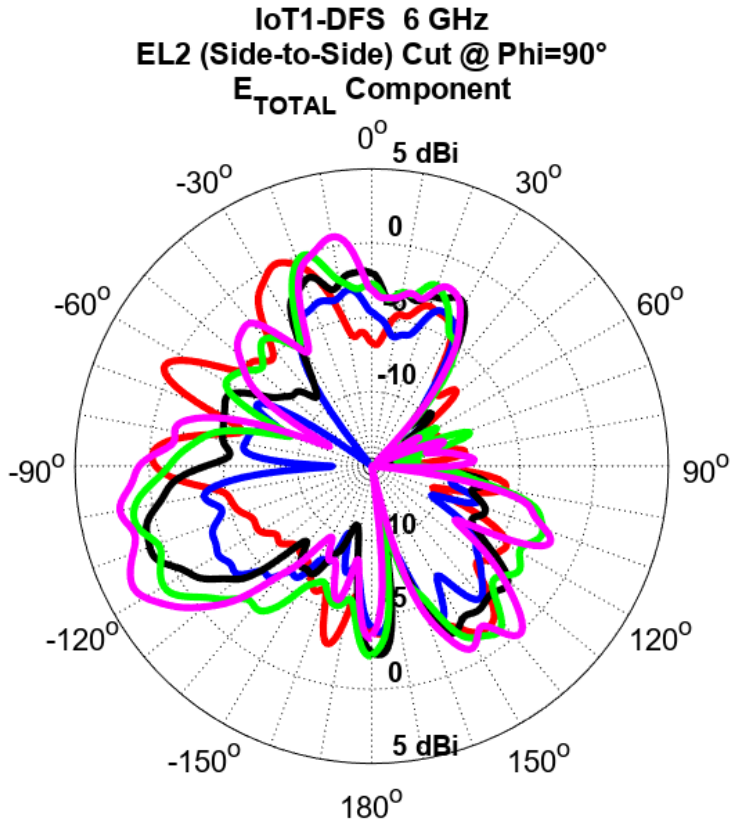
5150 MHz
5250 MHz
5350 MHz
5500 MHz
5725 MHz
5825 MHz



DFS-5 GHz

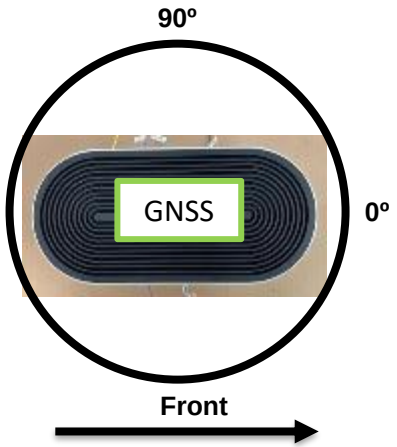


5925 MHz
6300 MHz
6500 MHz
6800 MHz
7125 MHz

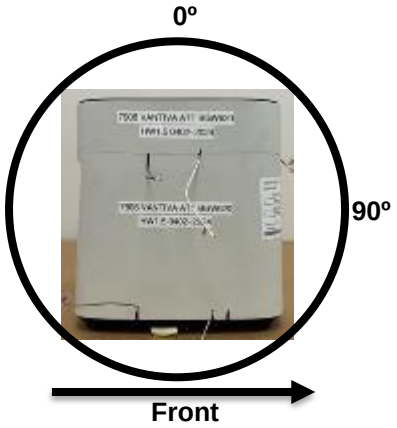


DFS-6 GHz

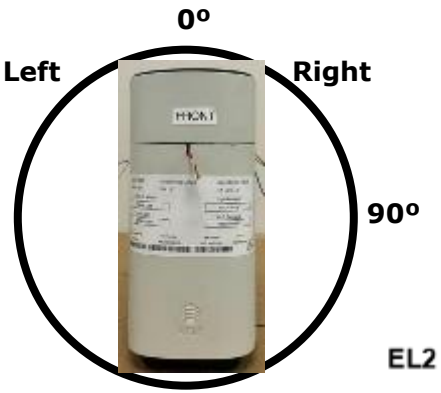
GNSS Antenna Power Sum Gain Patterns

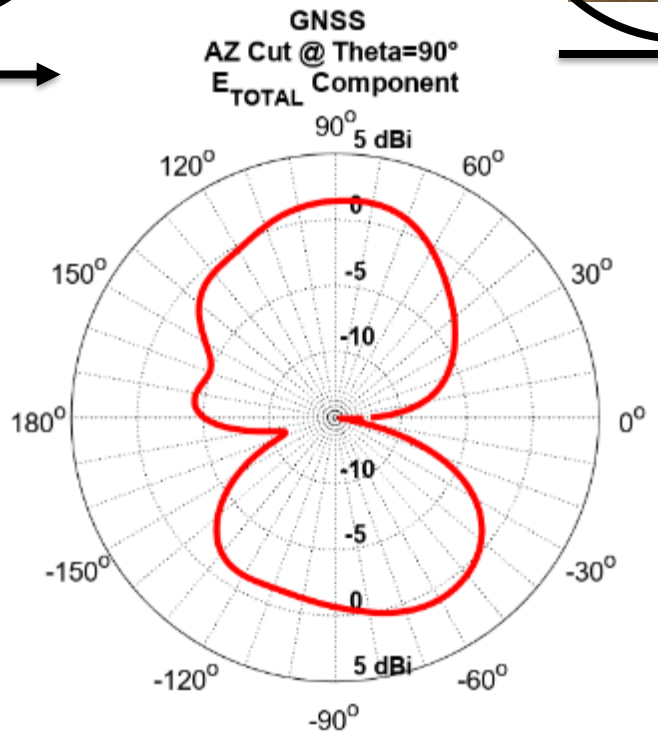


1575 MHz

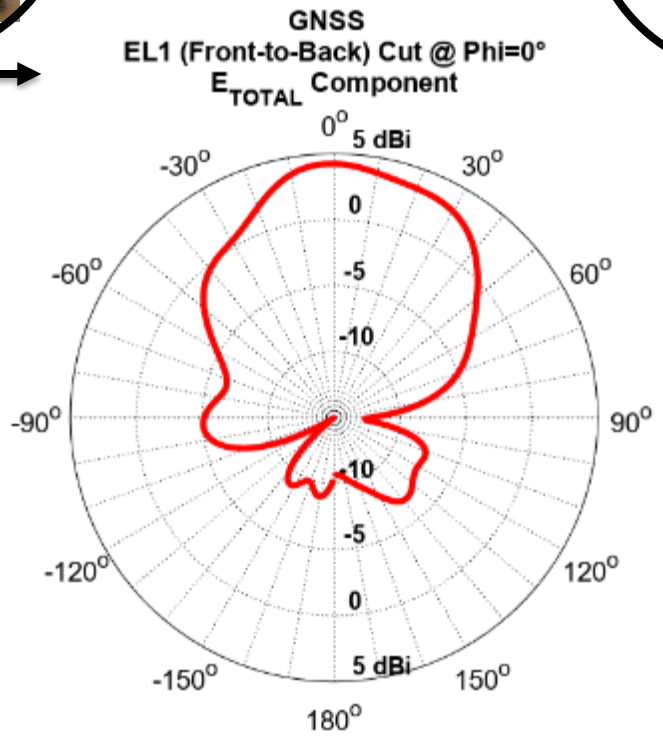


1575 MHz

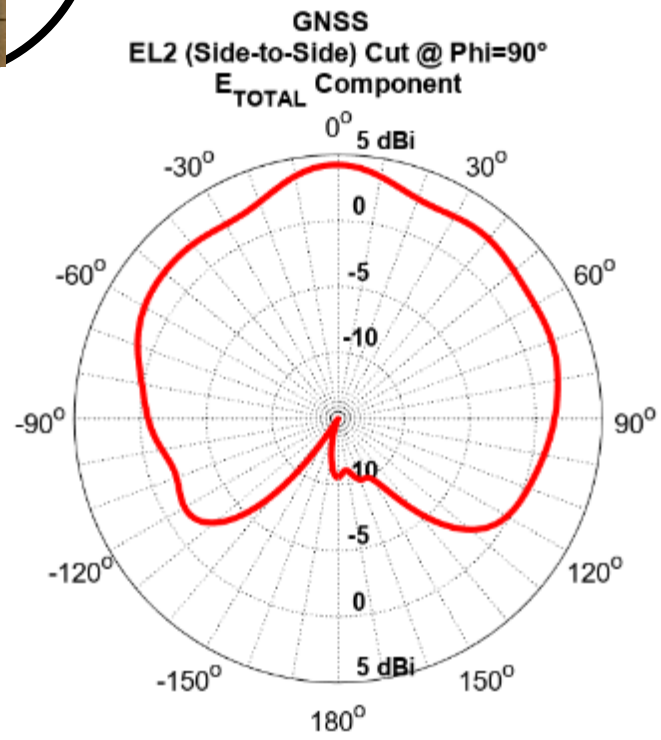




Azimuth Cut ($\theta = 90°$)

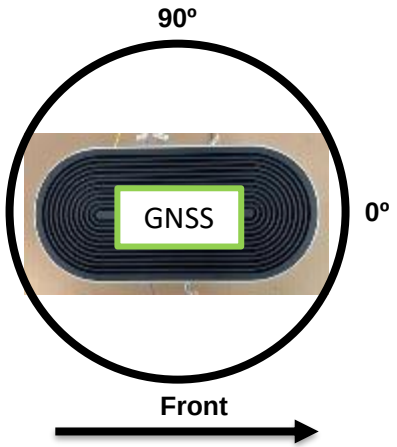


Elevation
(Front to Back) Cut

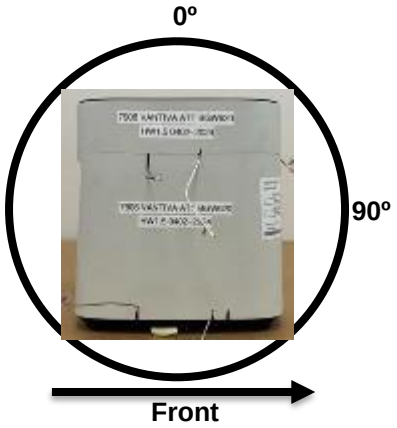


Elevation
(Side to Side) Cut

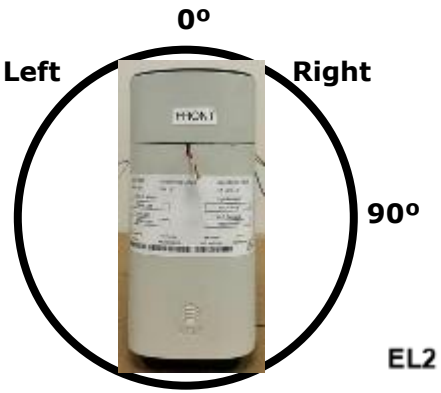
GNSS Antenna Power Sum Gain Patterns

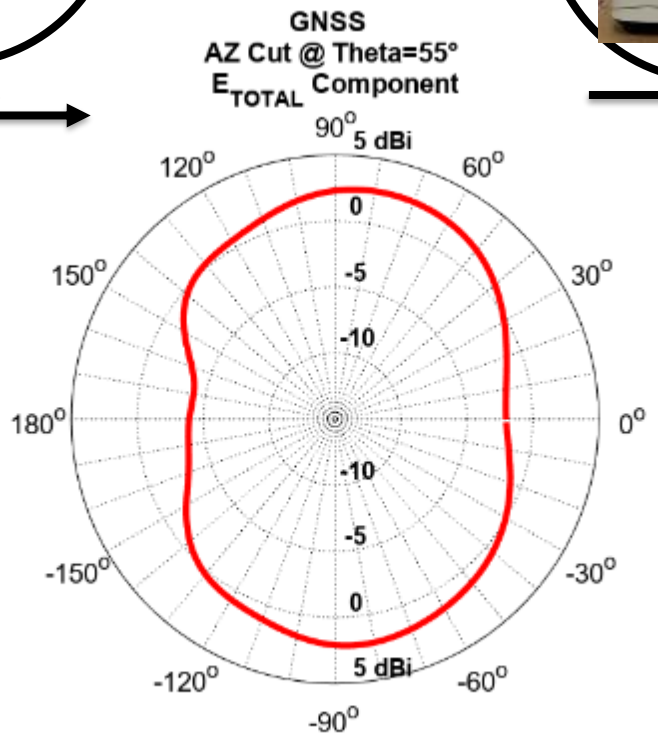


1575 MHz

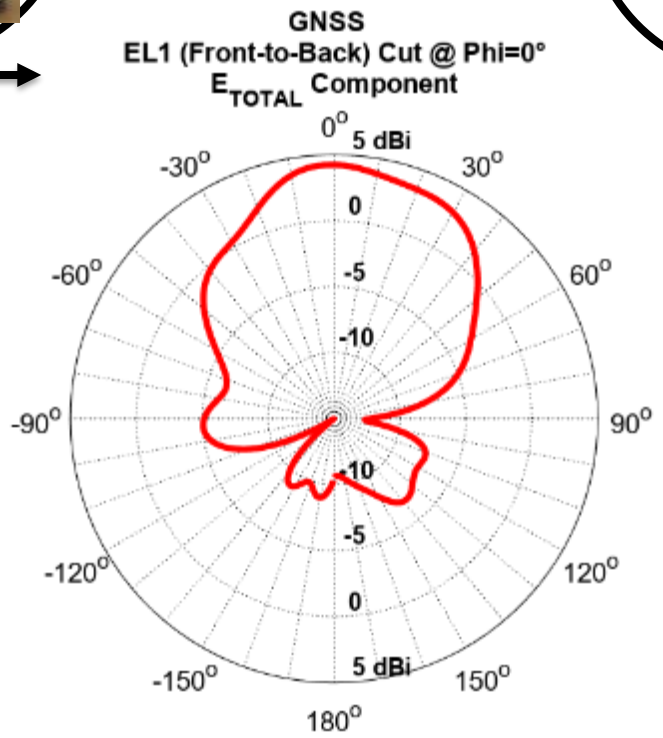


1575 MHz

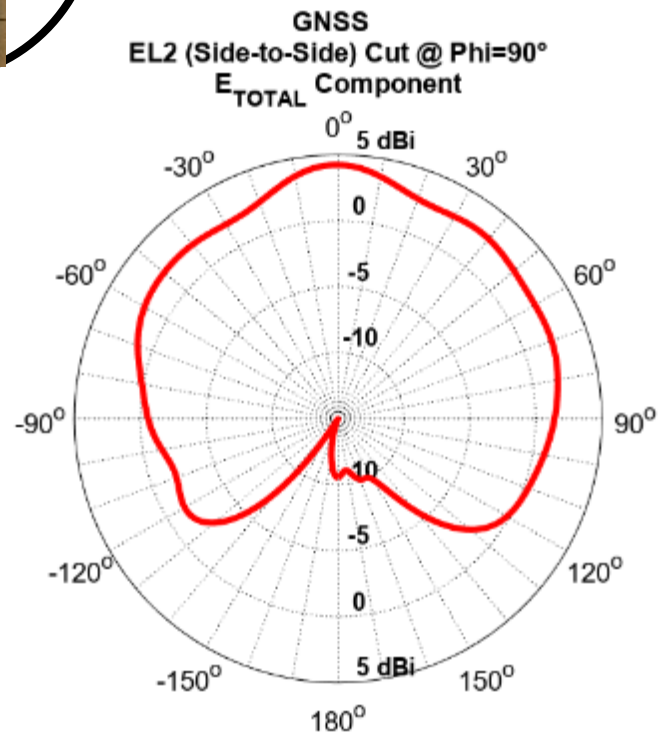




Azimuth Cut ($\theta = 35°$)
GPS inclination angle is 55°

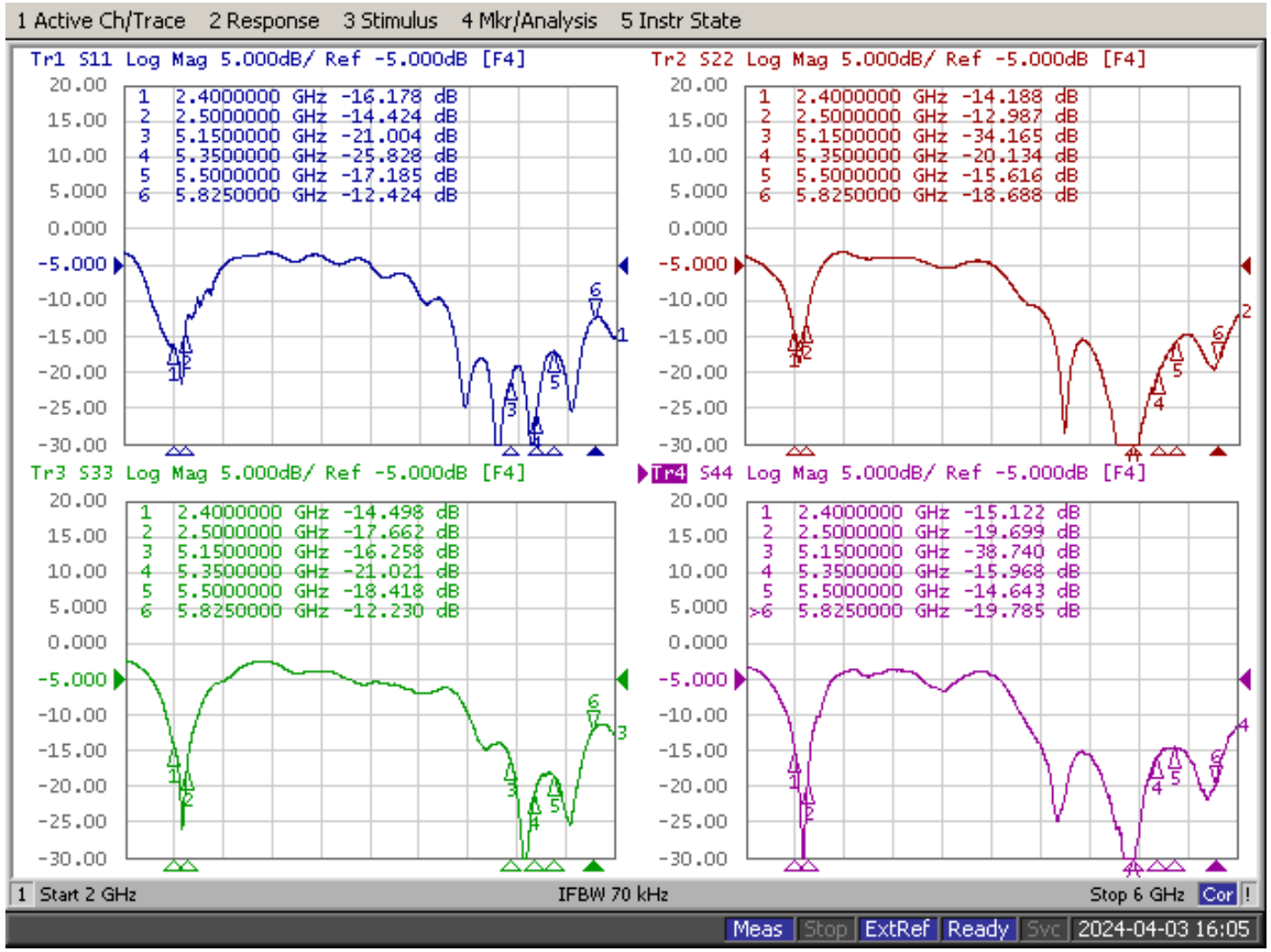


Elevation
(Front to Back) Cut



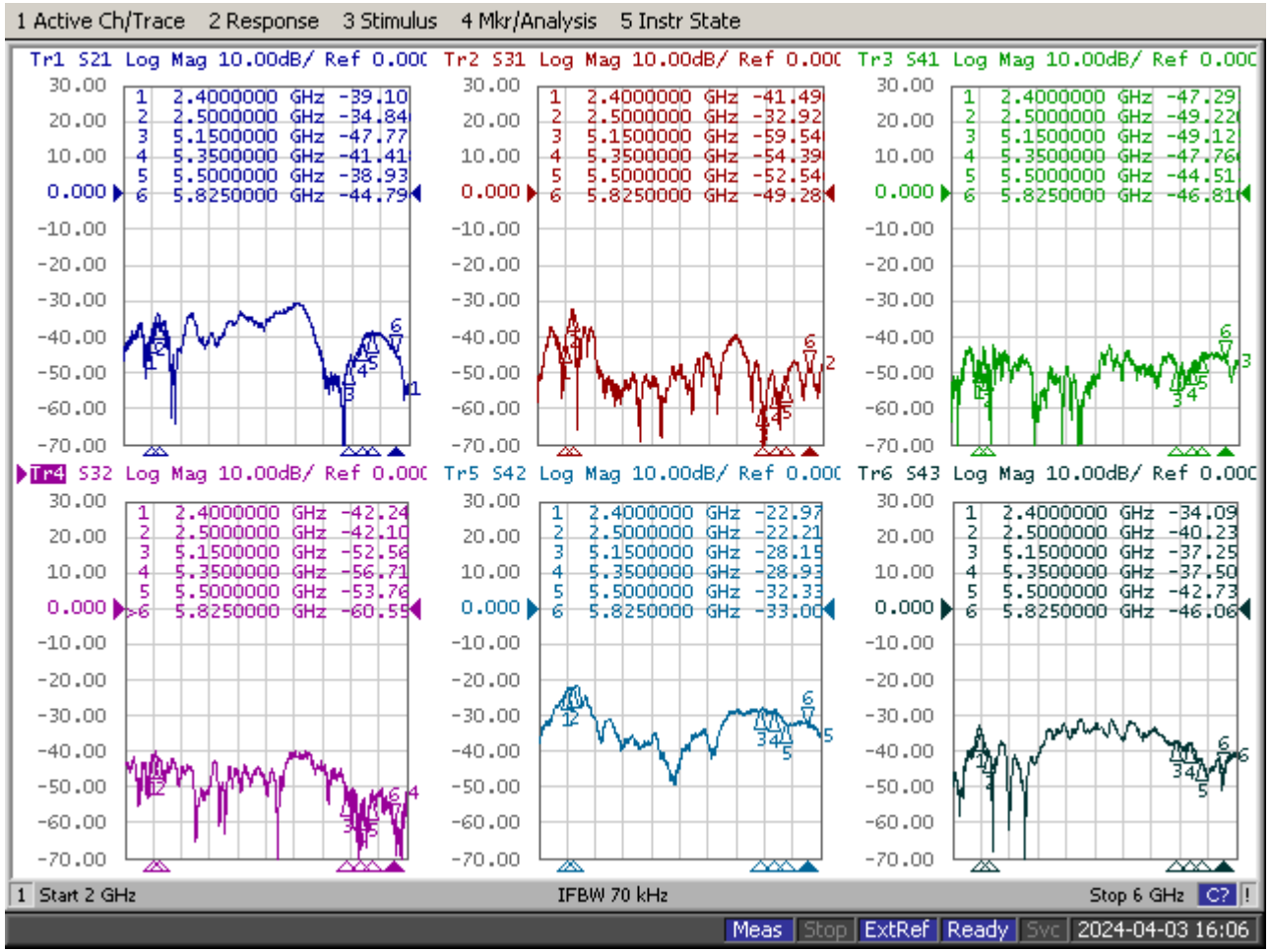
Elevation
(Side to Side) Cut

Return Loss of the Dual Band Antennas



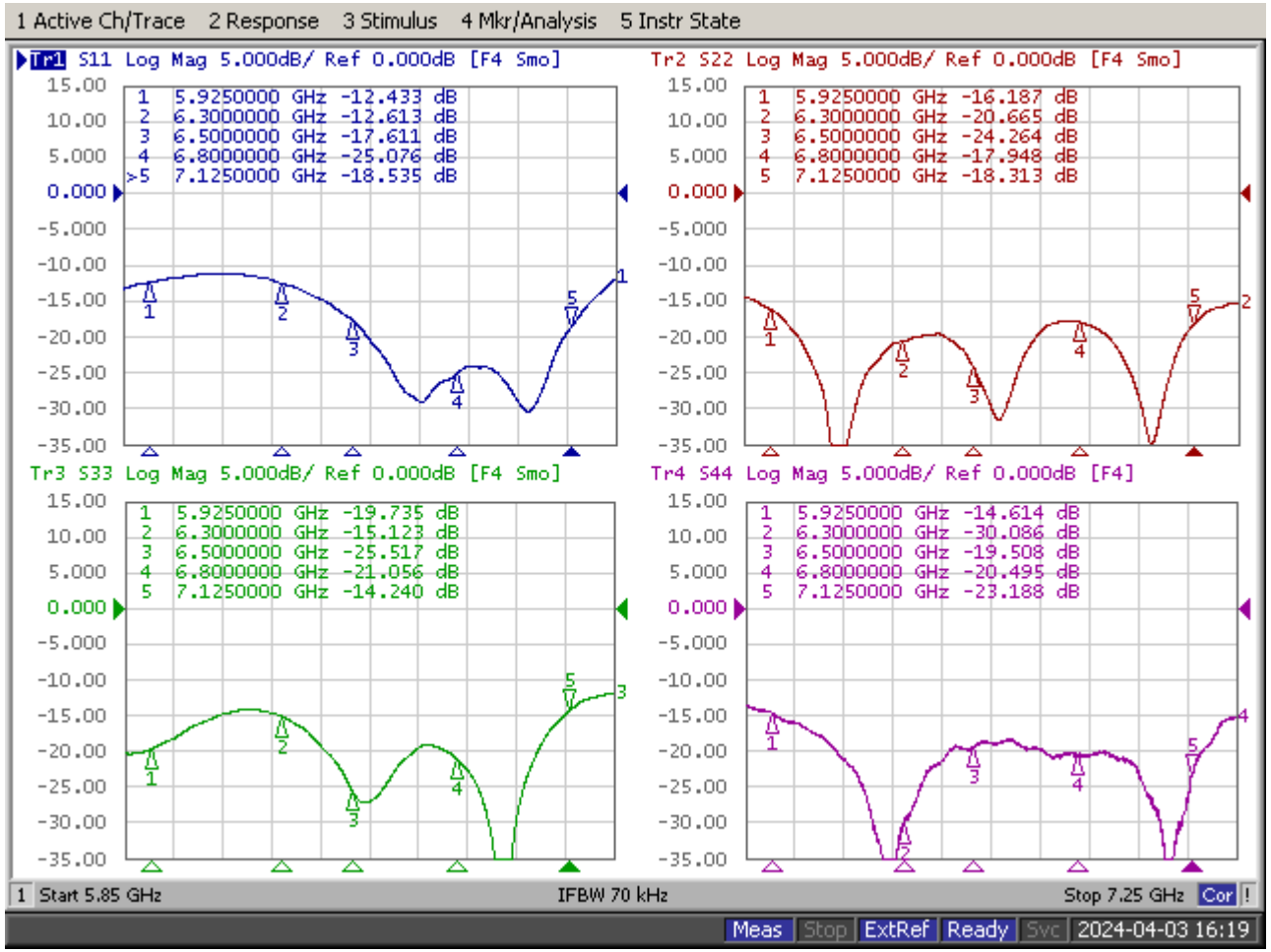
Port 1= DB1	Port 2= DB2
Port 3= DB3	Port 4= DB4

Isolation of the Dual Band Antennas



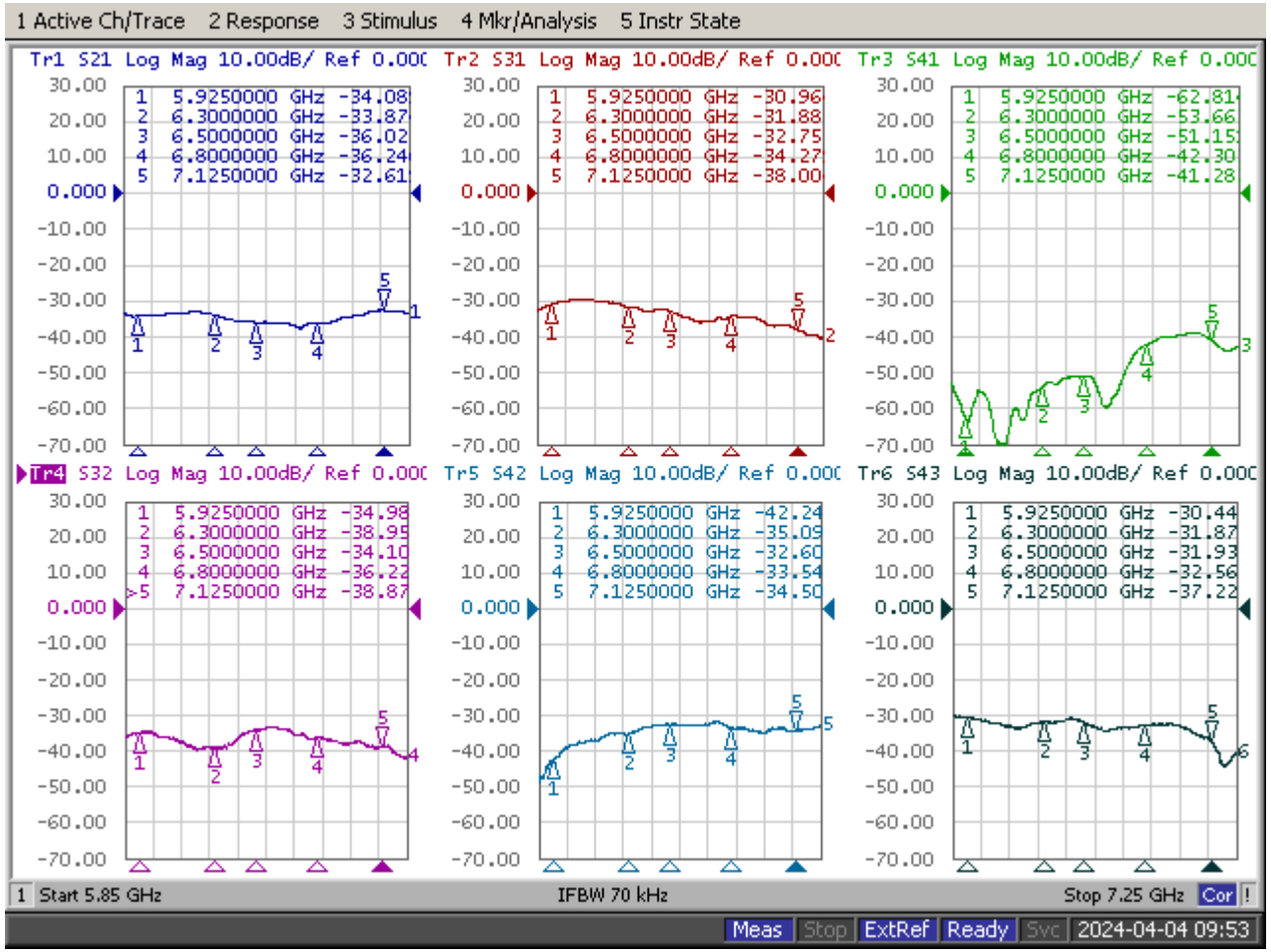
Port 1= DB1	Port 2= DB2
Port 3= DB3	Port 4= DB4

Return Loss of 6 GHz Antennas



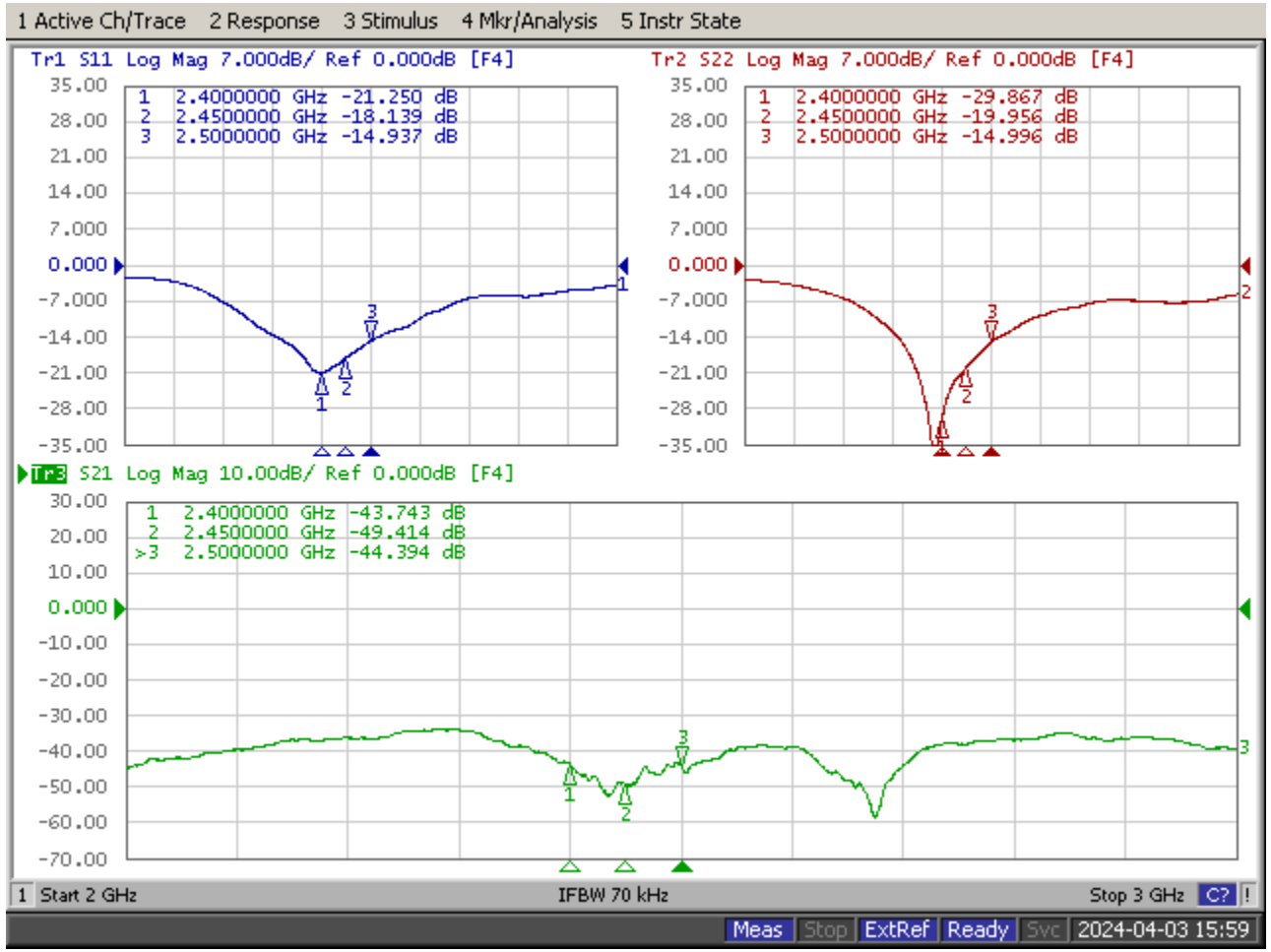
Port 1= 6G1	Port 2=6G2
Port 3= 6G3	Port 4= 6G4

Isolation between 6 GHz Antennas



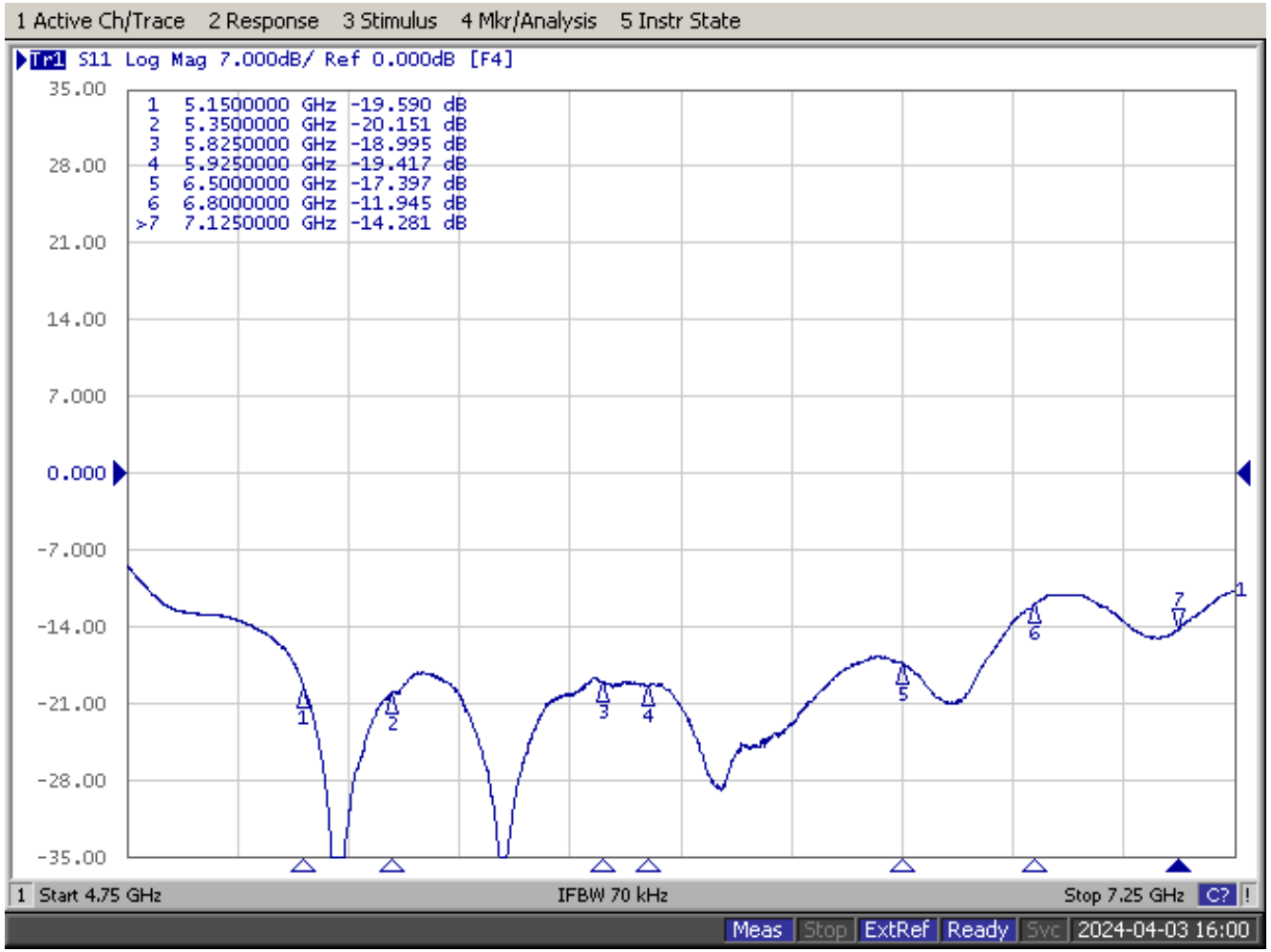
Port 1= 6G1	Port 2=6G2
Port 3= 6G3	Port 4= 6G4

Return Loss and Isolation of IoT antennas

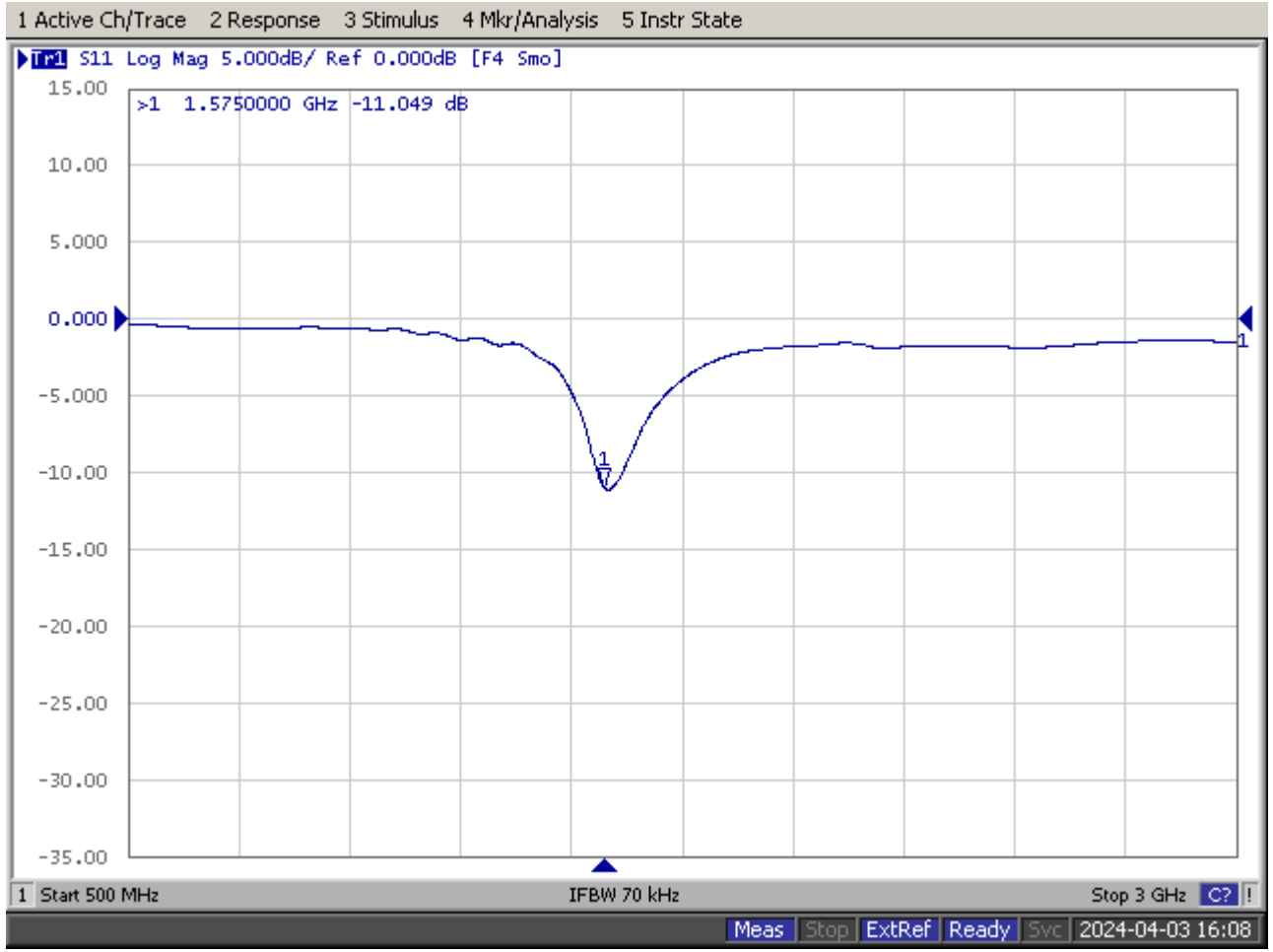


Port 1= IoT1	Port 2= IoT2

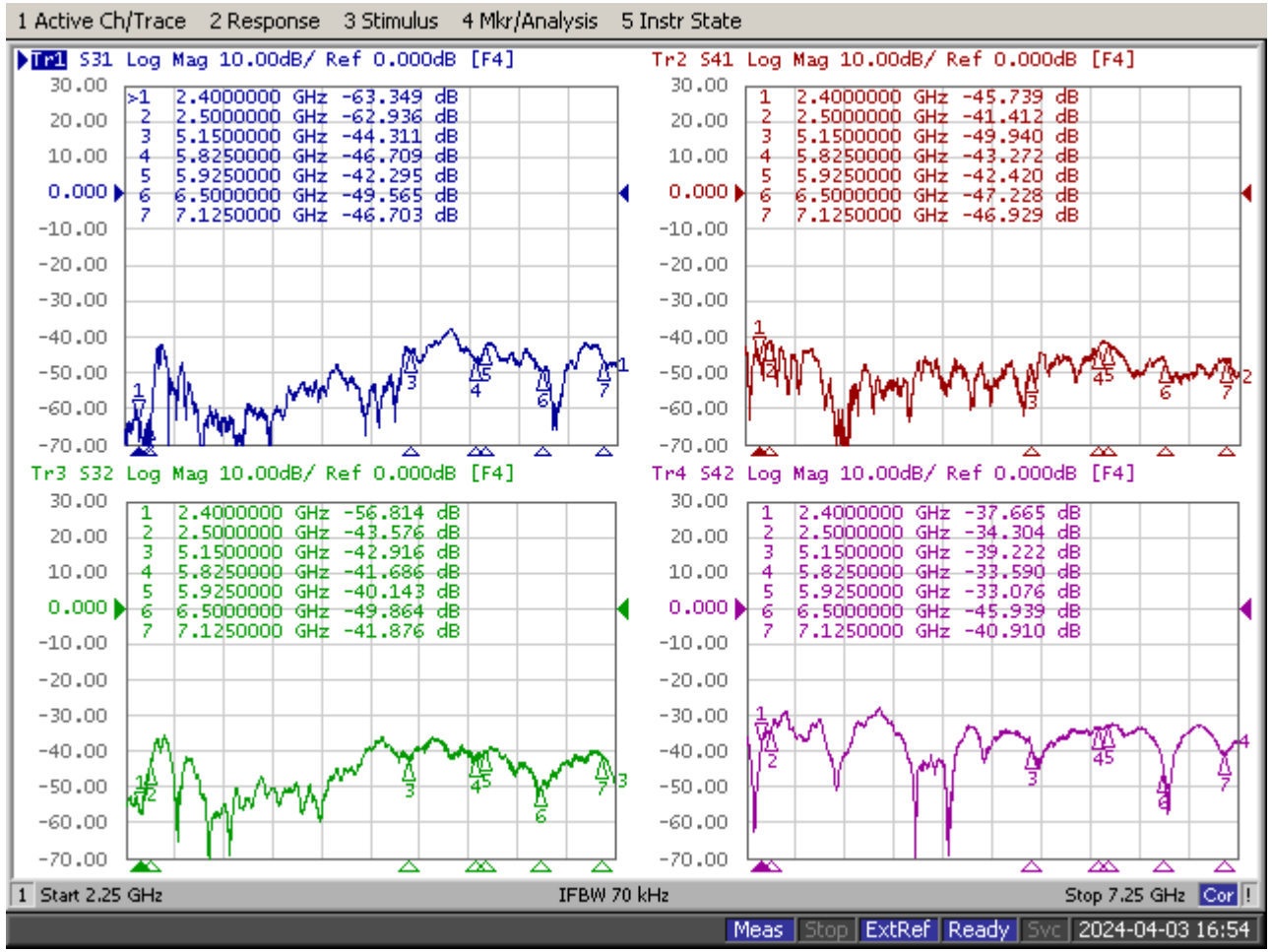
Return Loss of the DFS Antenna



Return Loss of the GNSS Antenna

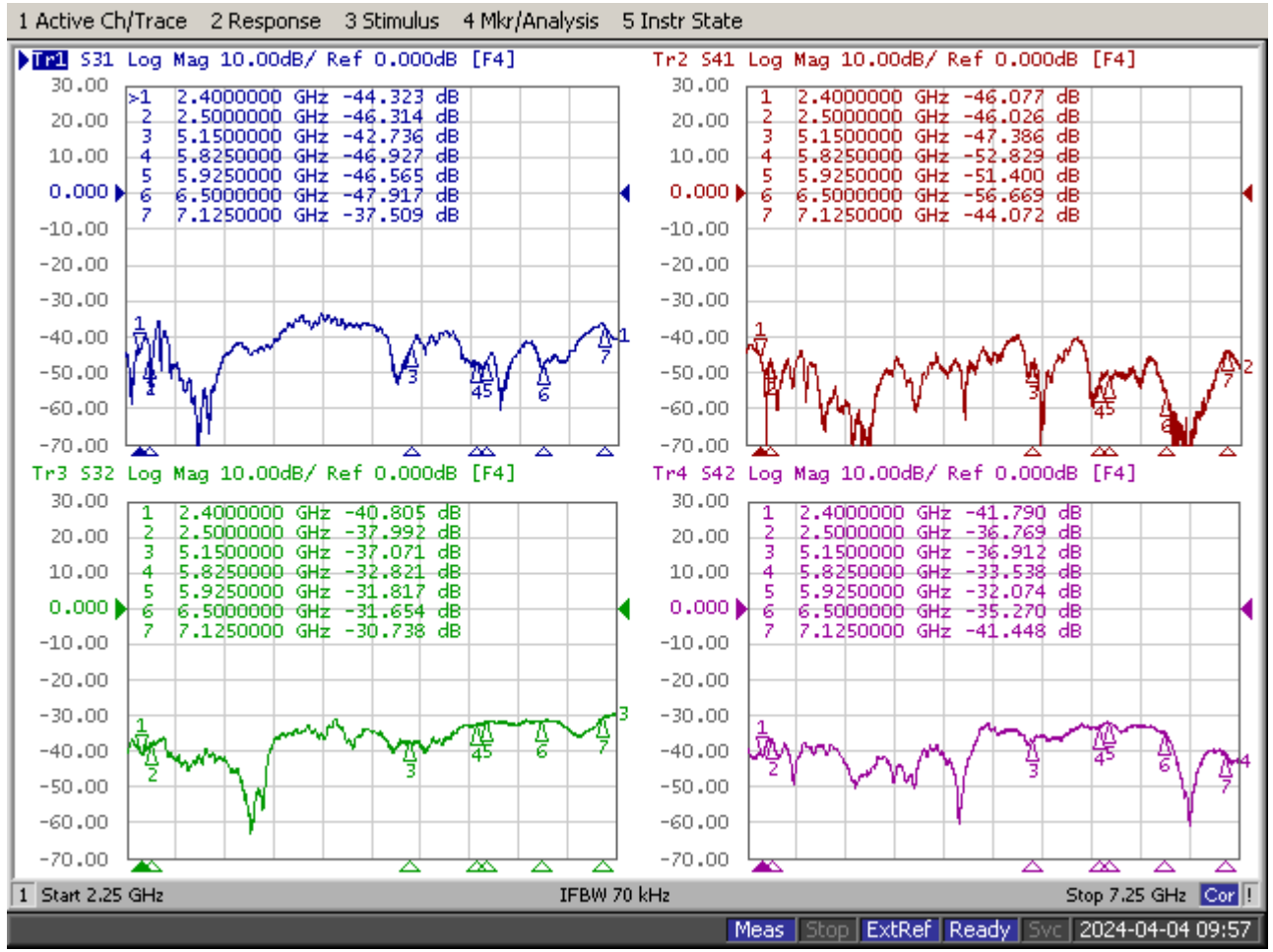


Isolation between DB and 6 GHz Antennas



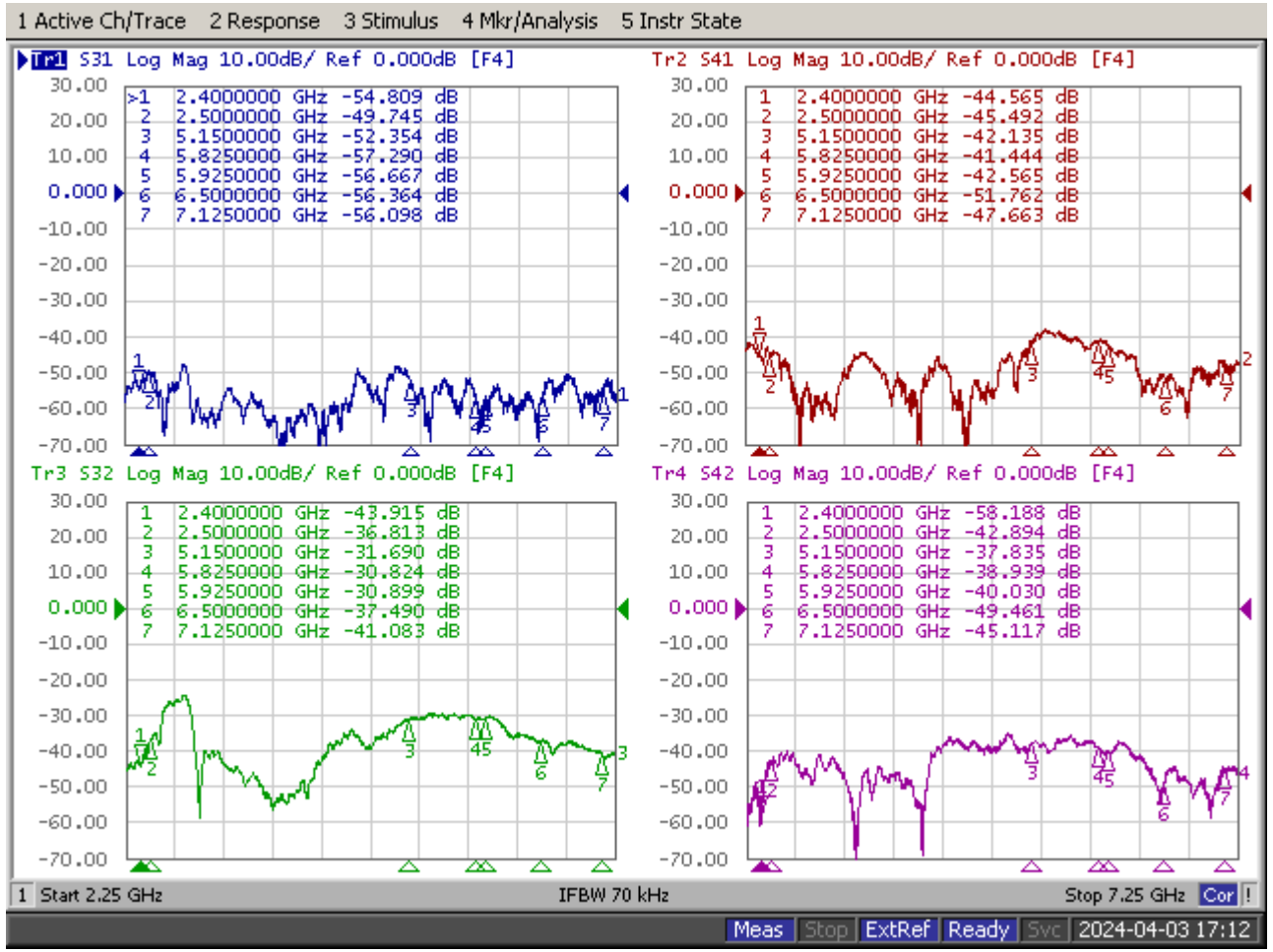
Port 1= DB1	Port 2= DB2
Port 3= 6G1	Port 4= 6G2

Isolation between DB and 6 GHz Antennas



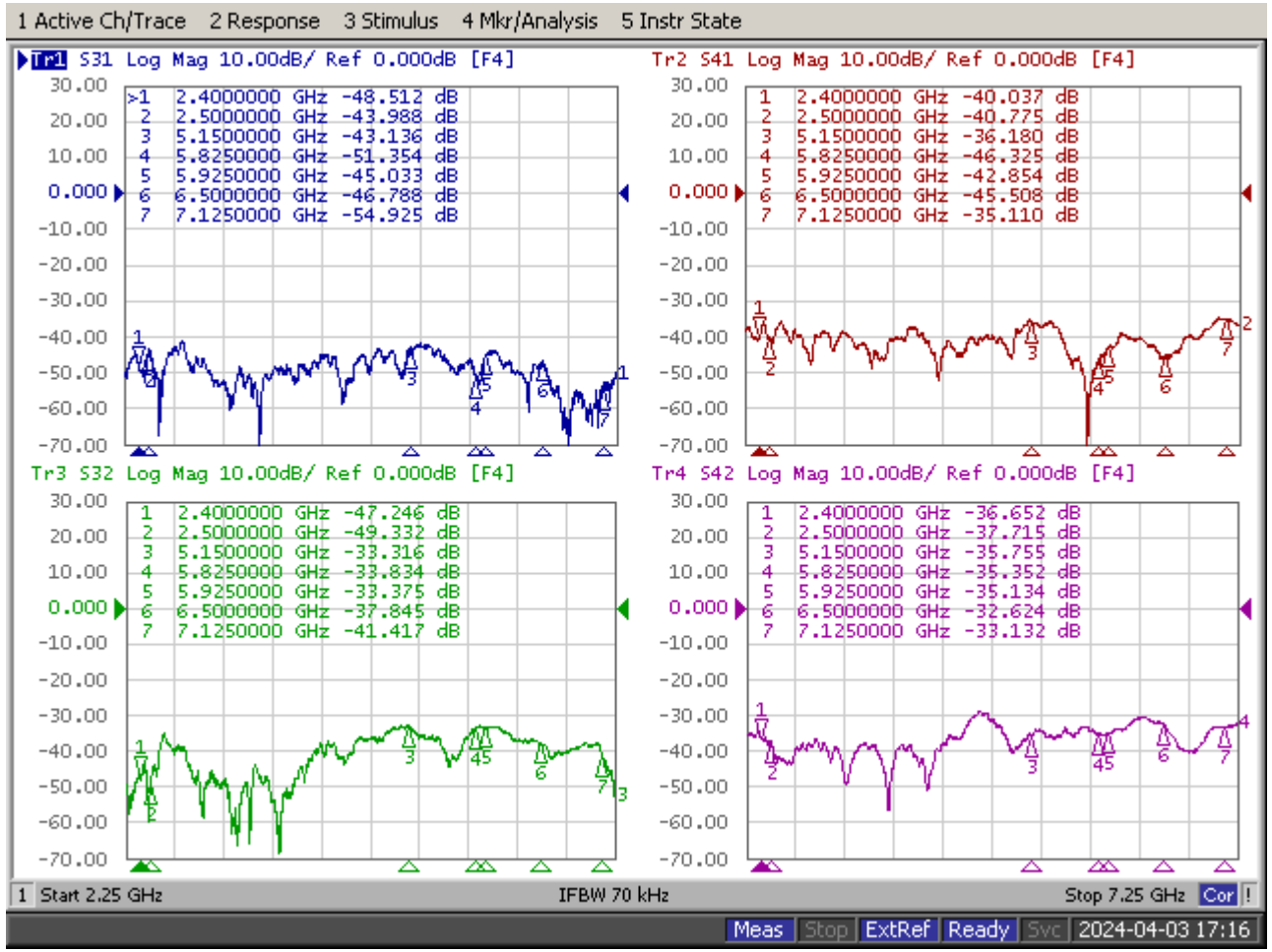
Port 1= DB1	Port 2= DB2
Port 3= 6G3	Port 4= 6G4

Isolation between DB and 6 GHz Antennas



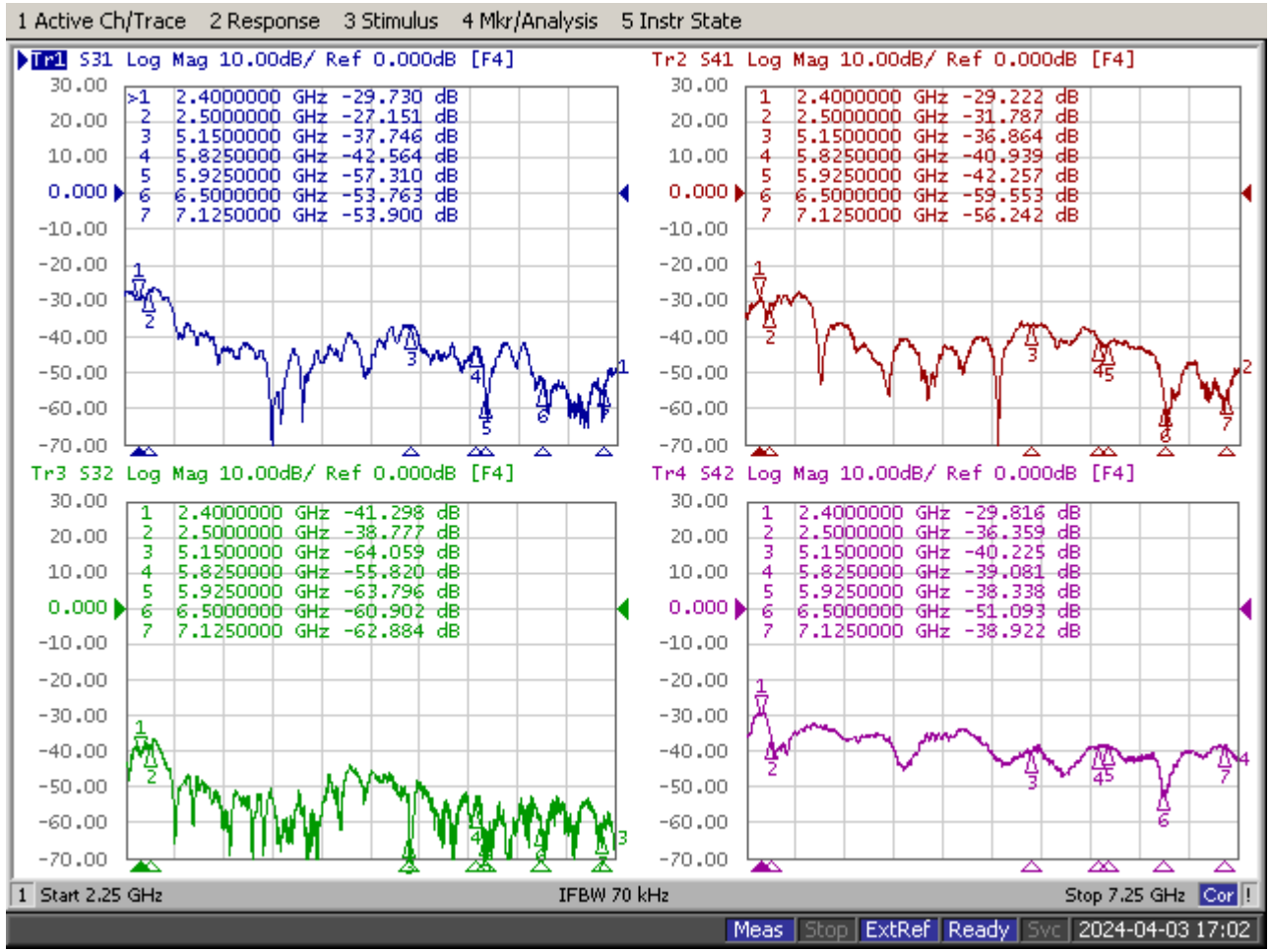
Port 1= DB3	Port 2= DB4
Port 3= 6G1	Port 4= 6G2

Isolation between DB and 6 GHz Antennas



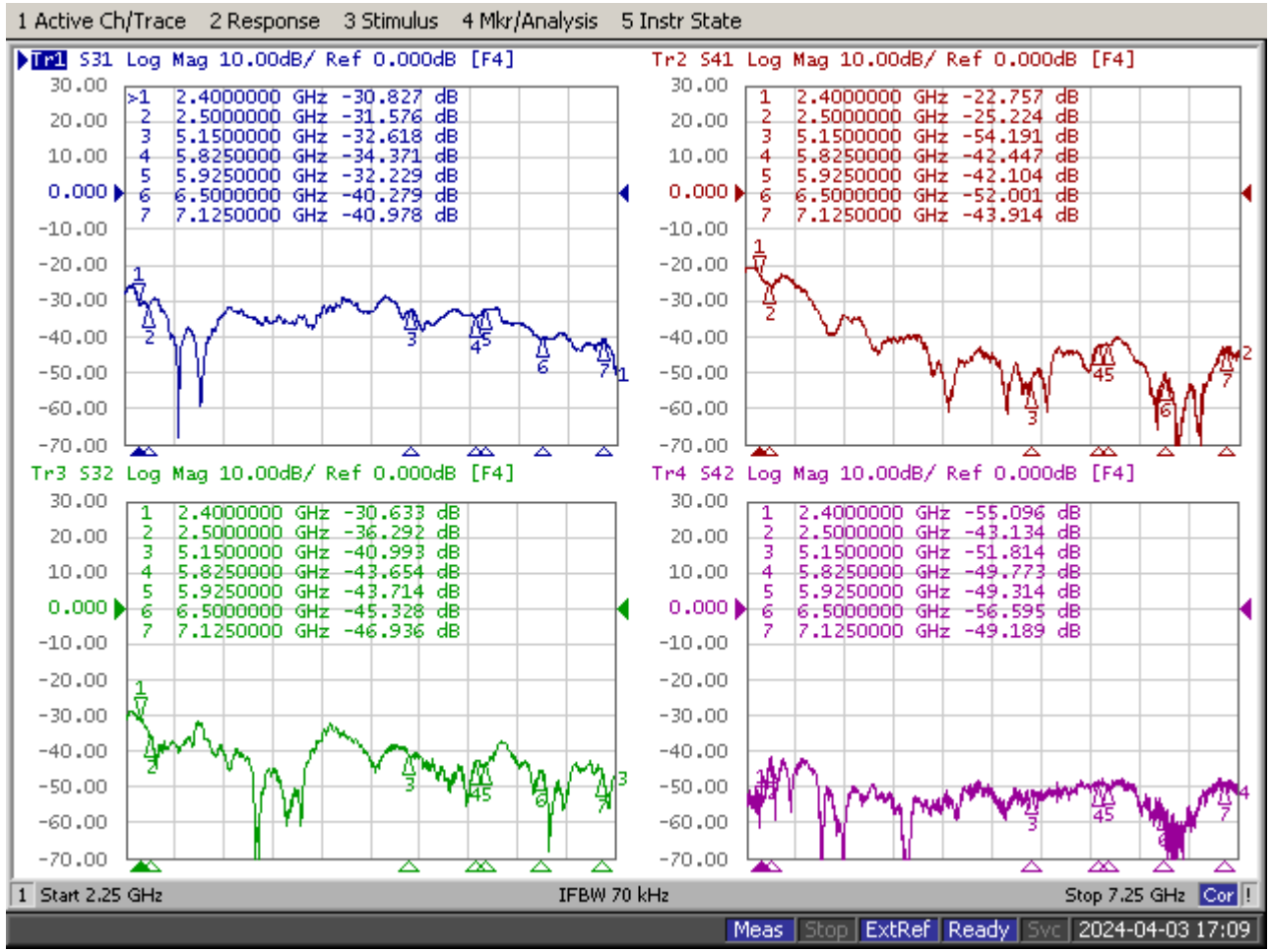
Port 1= DB3	Port 2= DB4
Port 3= 6G3	Port 4= 6G4

Isolation between DB, IoT and DFS Antennas



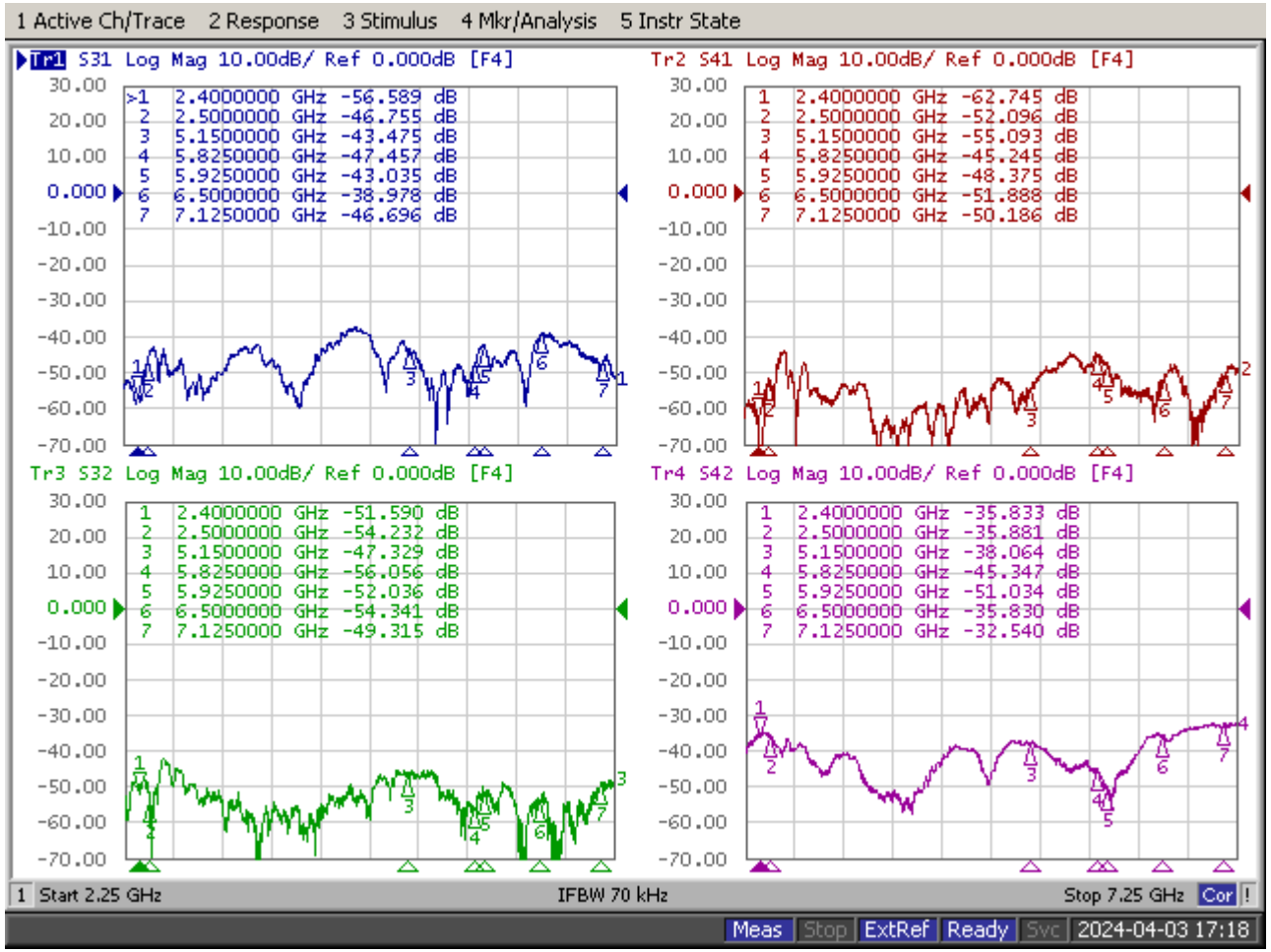
Port 1= DB1	Port 2= DB2
Port 3= IoT1-DFS	Port 4= IoT2

Isolation between DB, IoT and DFS Antennas



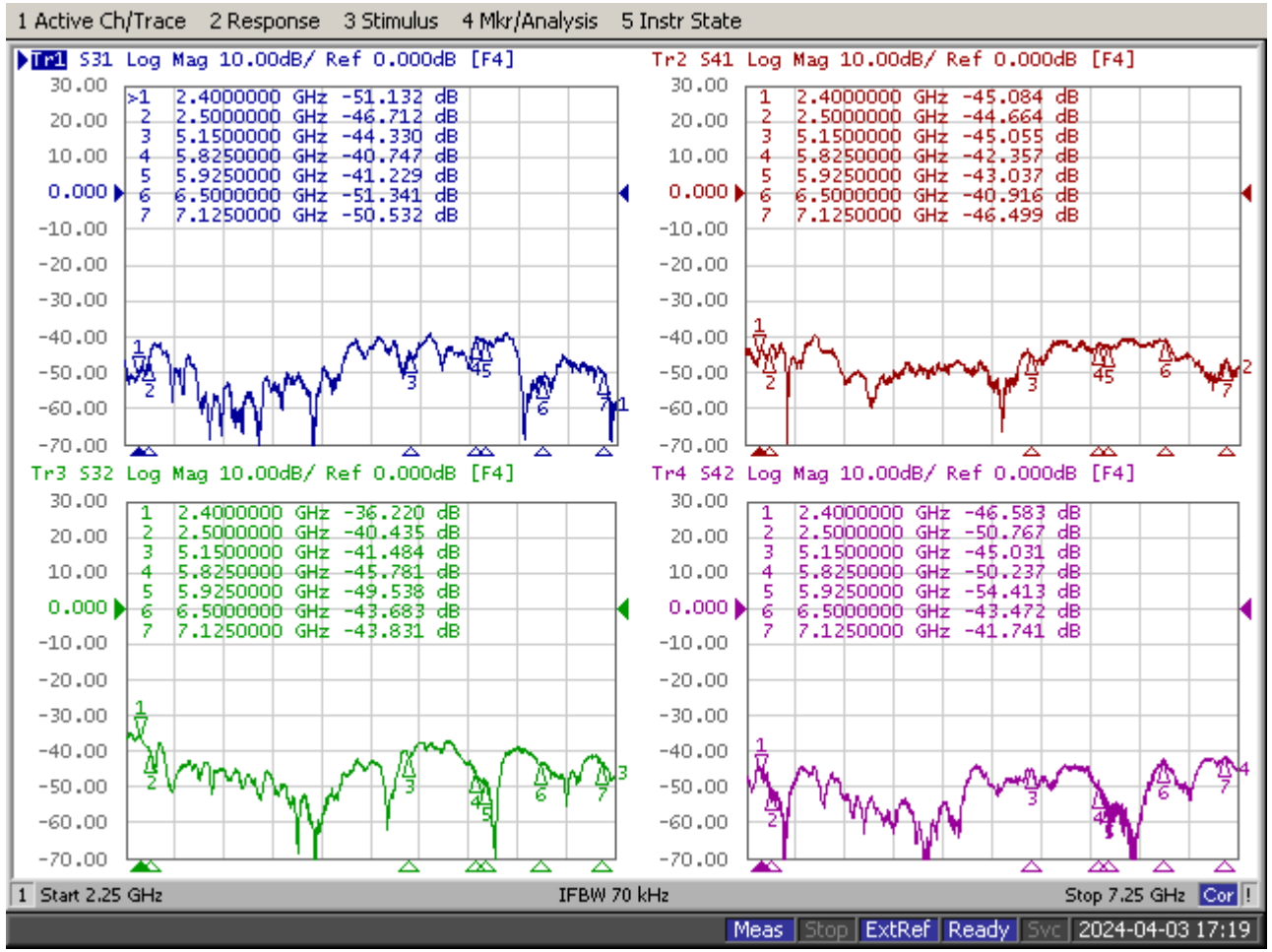
Port 1= DB3	Port 2= DB4
Port 3= IoT1-DFS	Port 4= IoT2

Isolation between 6 GHz, IoT and DFS Antennas



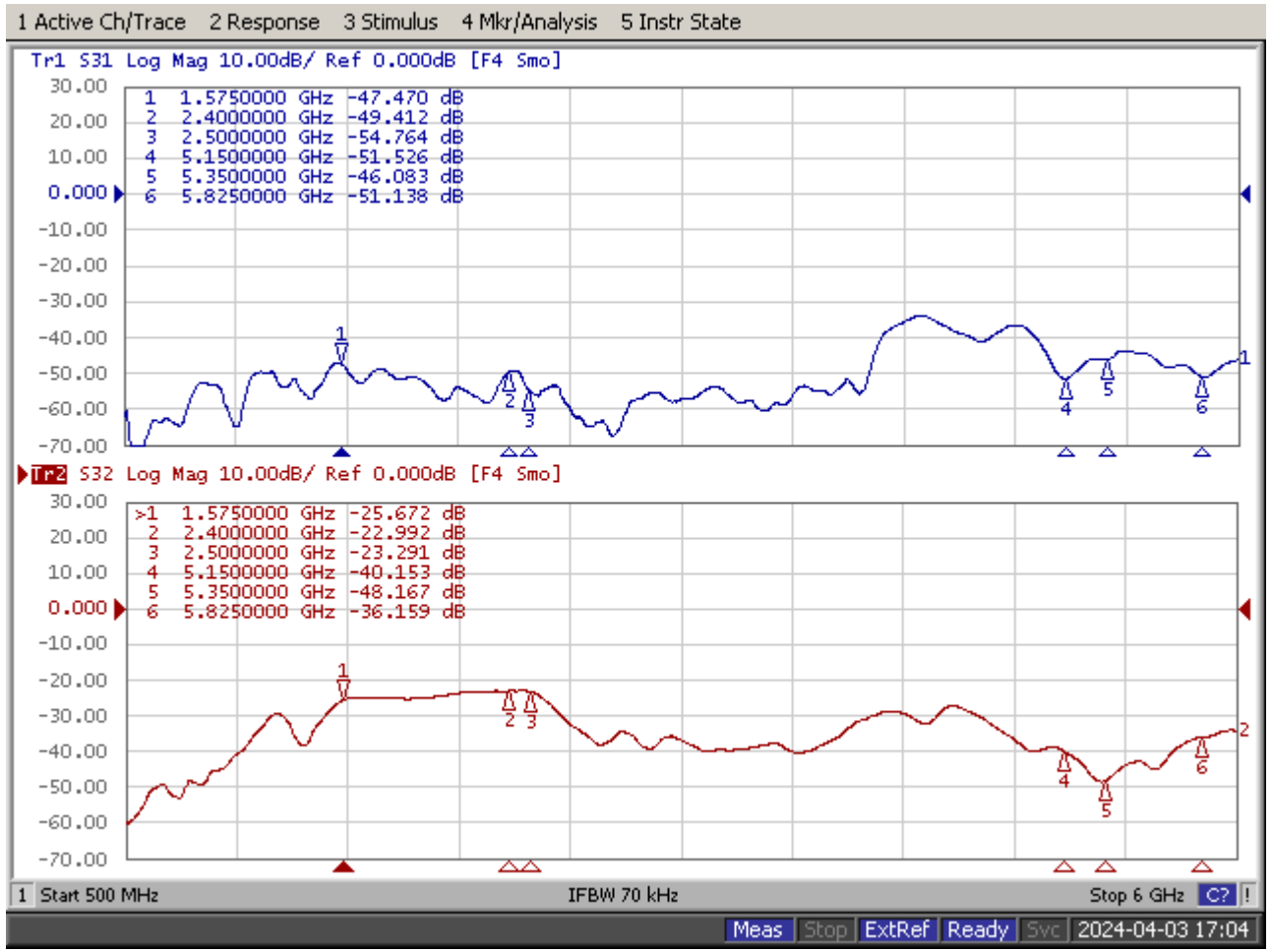
Port 1= 6G1	Port 2= 6G2
Port 3= IoT1-DFS	Port 4= IoT2

Isolation between 6 GHz, IoT and DFS Antennas



Port 1= 6G3	Port 2= 6G4
Port 3= IoT1-DFS	Port 4= IoT2

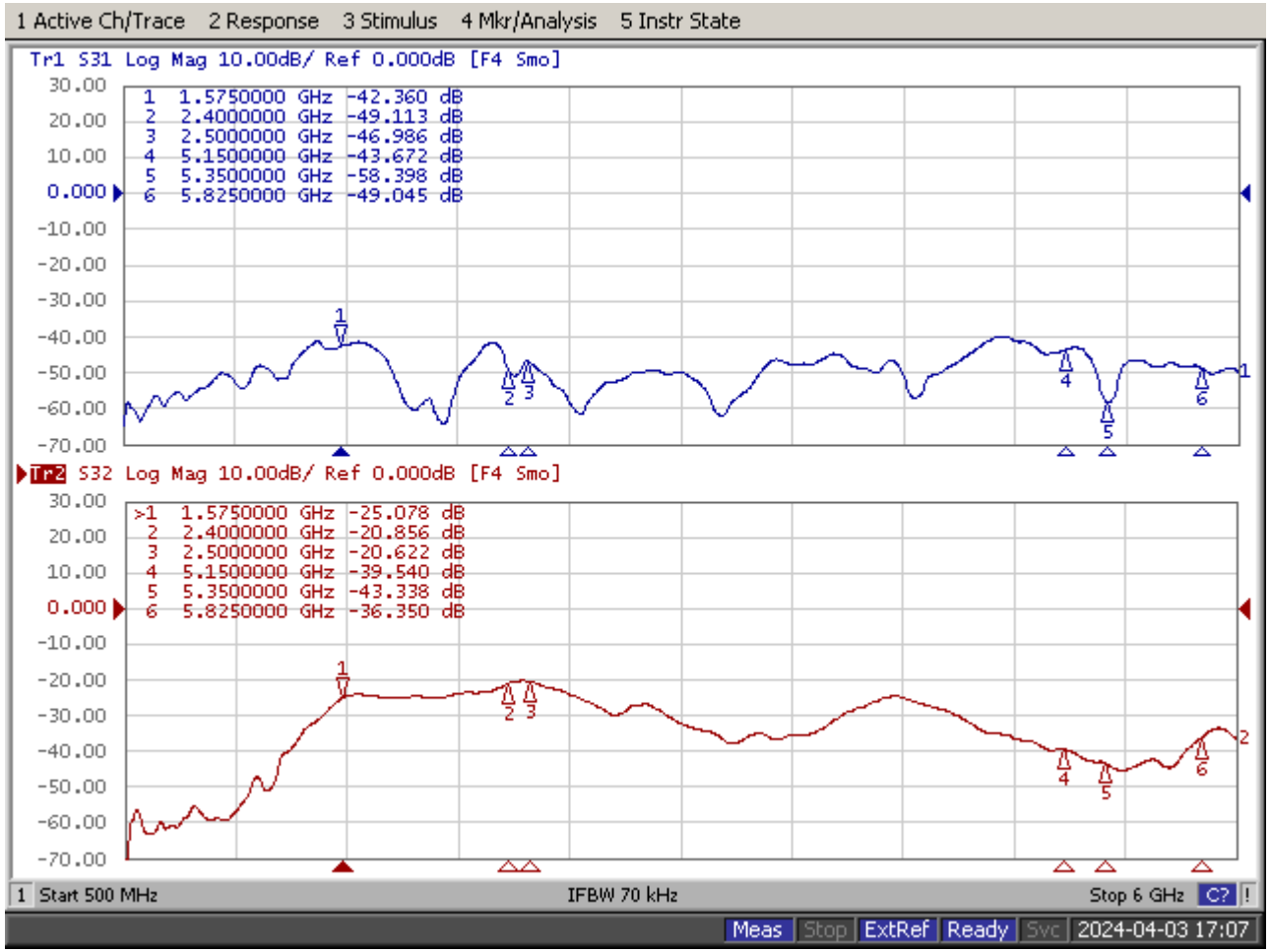
Isolation between DB and GNSS Antennas



Port 1= DB1 | Port 2= DB2

Port 3=GNSS

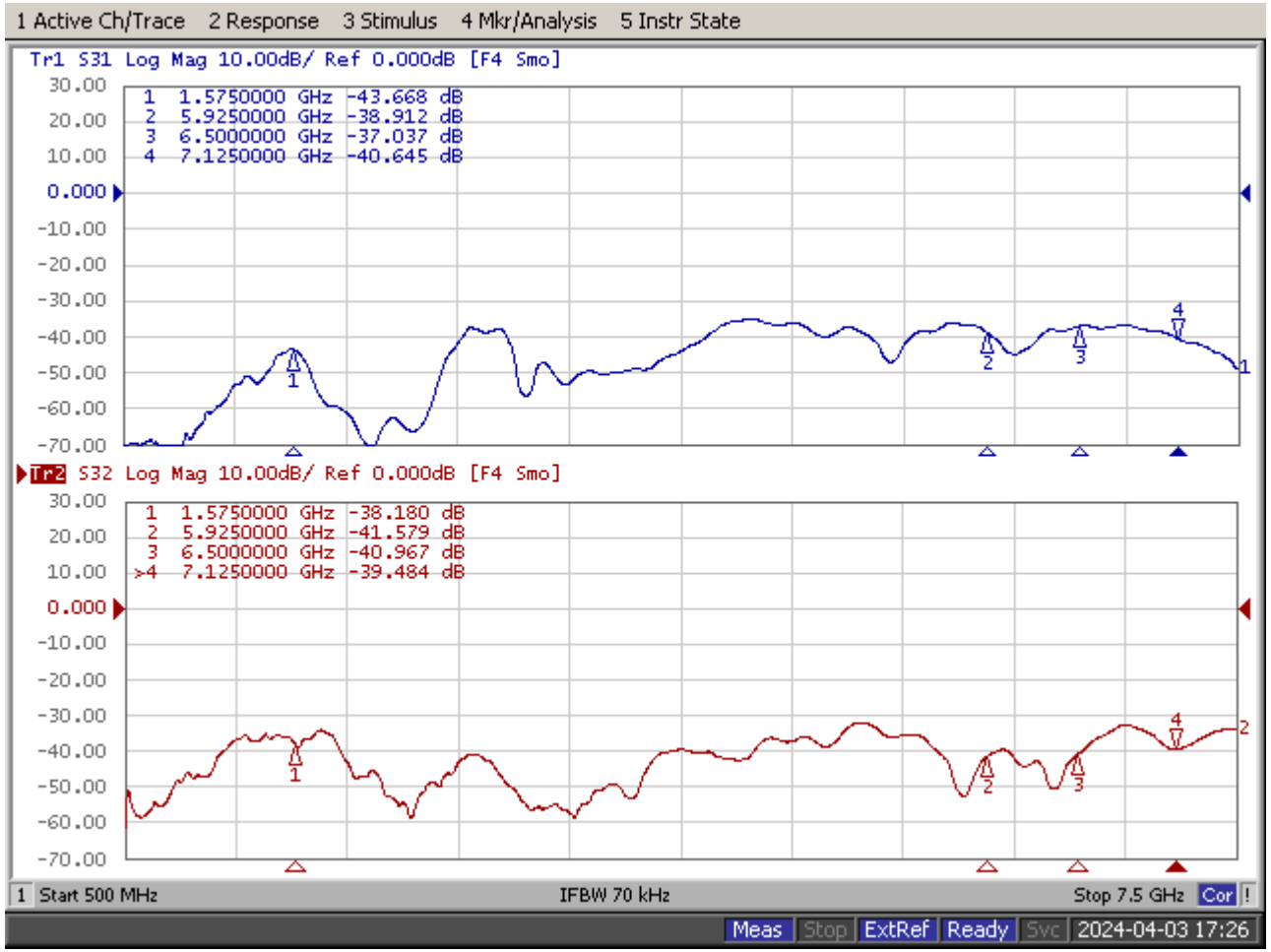
Isolation between DB and GNSS Antennas



Port 1= DB3 | Port 2= DB4

Port 3=GNSS

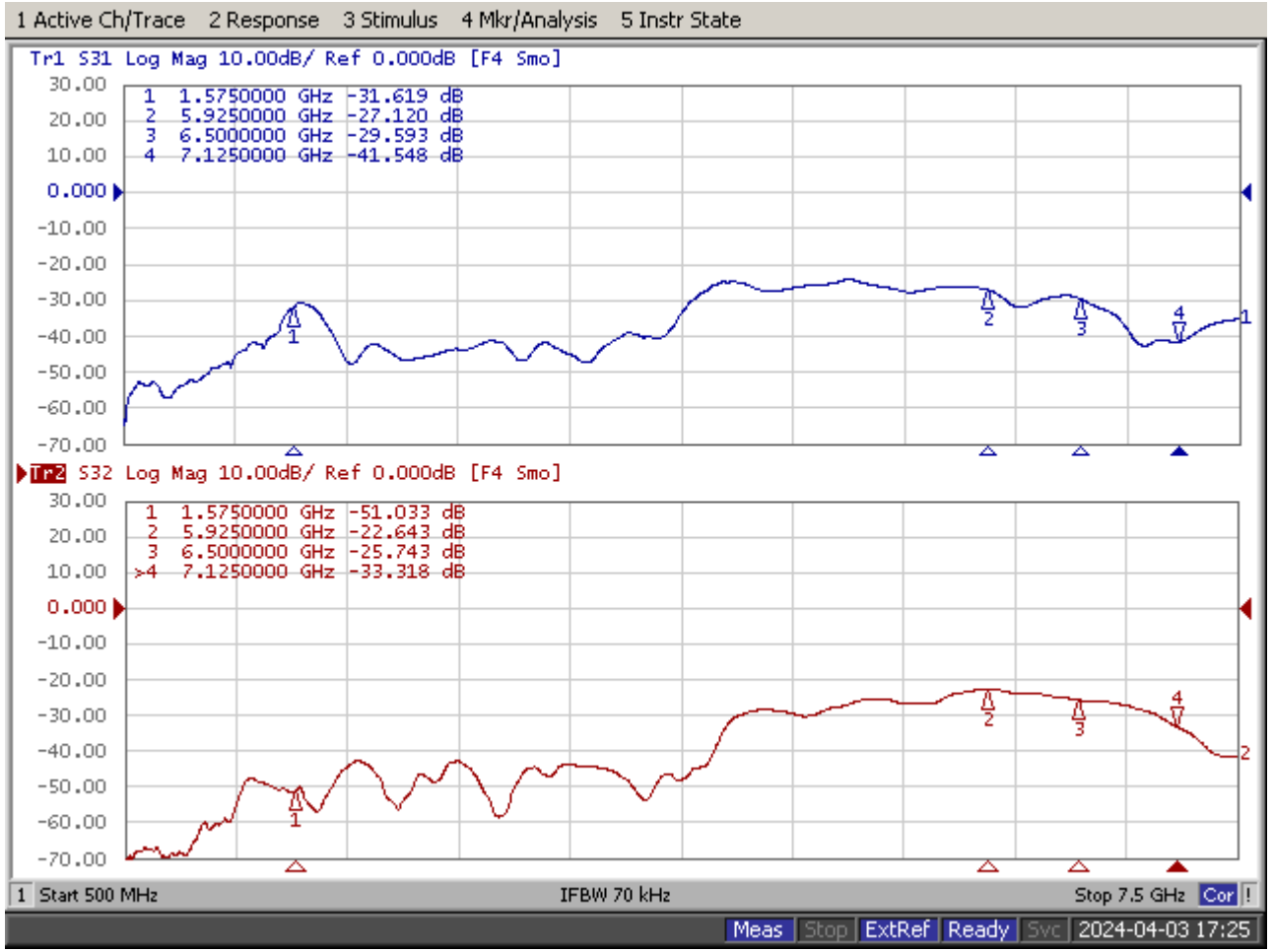
Isolation between 6 GHz and GNSS Antennas



Port 1= 6G1 | Port 2= 6G2

Port 3=GNSS

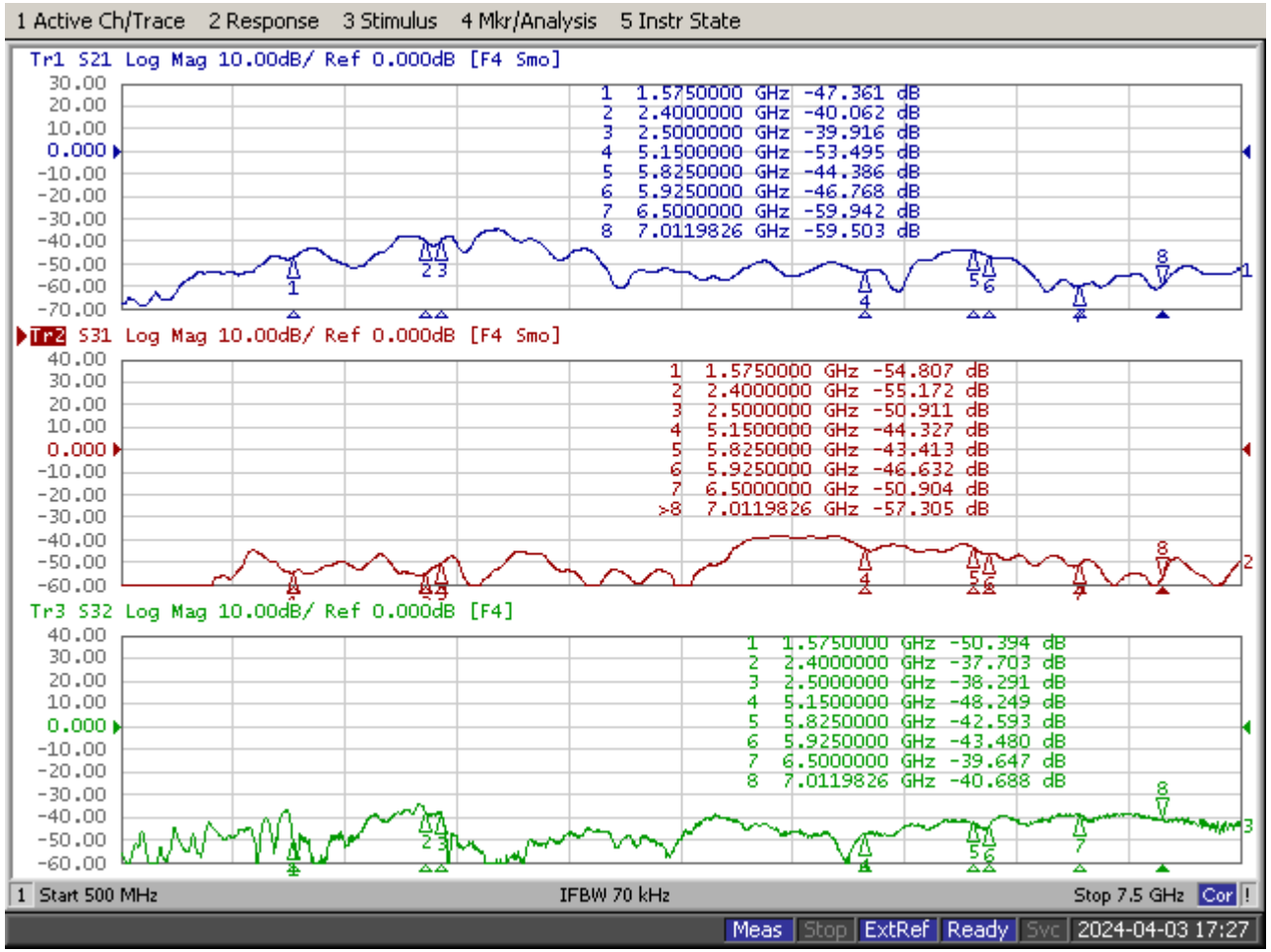
Isolation between 6 GHz and GNSS Antennas



Port 1= 6G3 | Port 2= 6G4

Port 3=GNSS

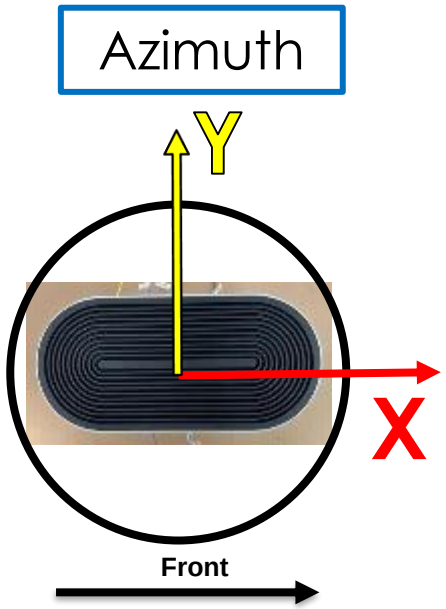
Isolation between IoT, DFS and GNSS Antennas

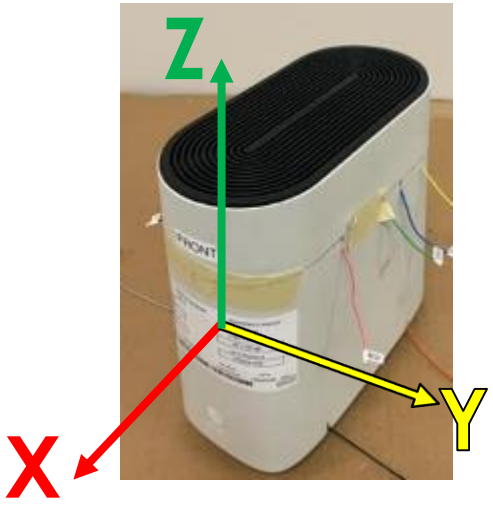


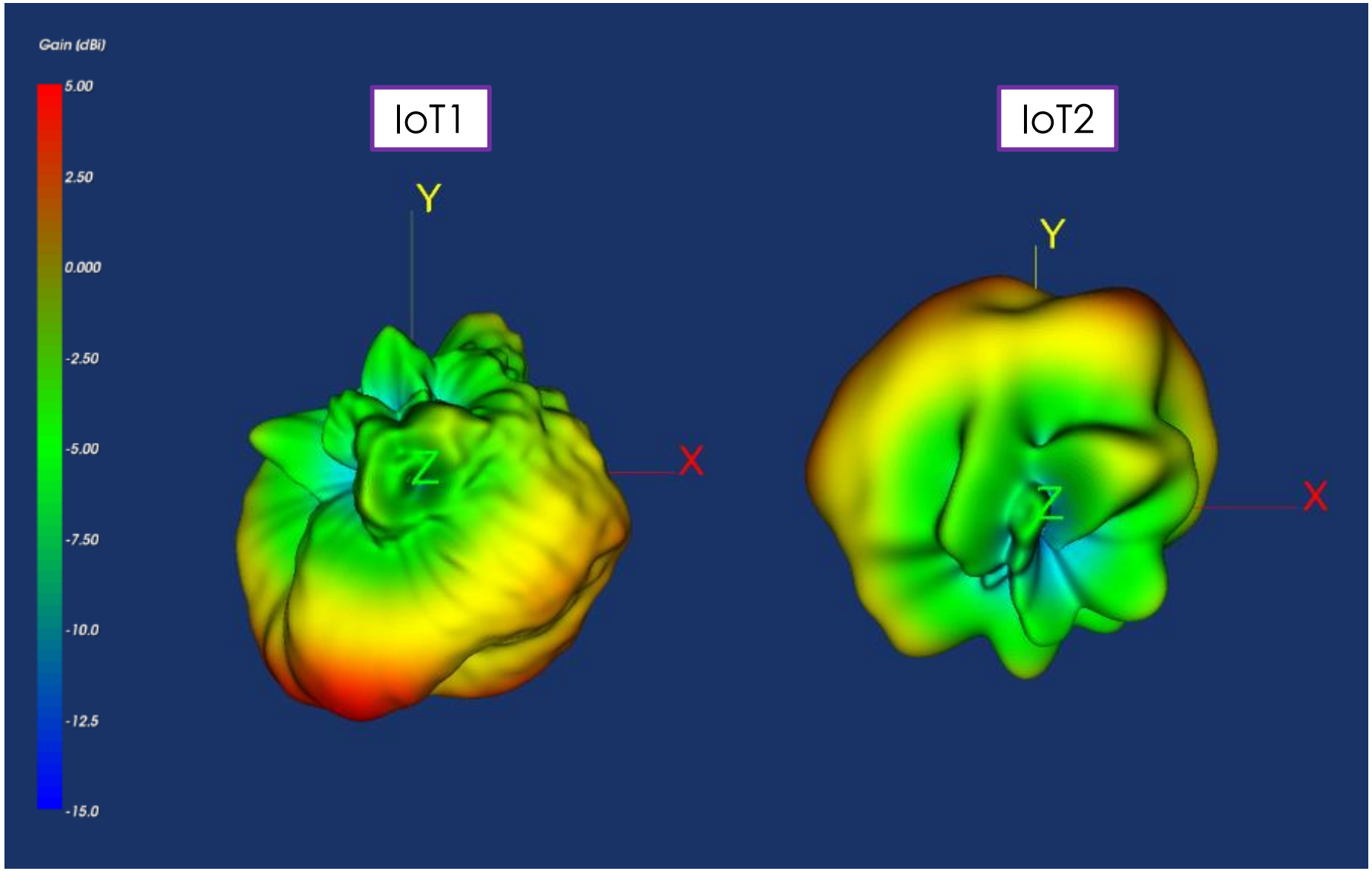
Port 1= IoT1-DFS | Port 2= IoT2

Port 3=GNSS

3D Gain Plot – IoT Antennas – 2.45 GHz

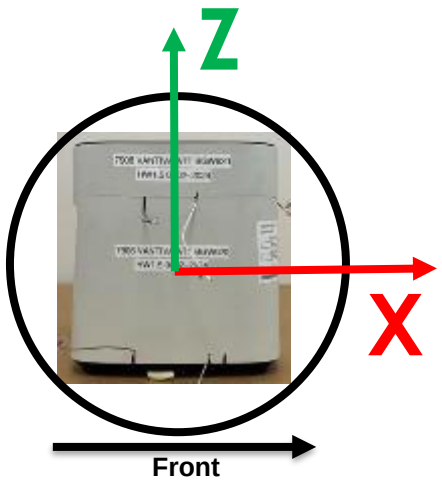


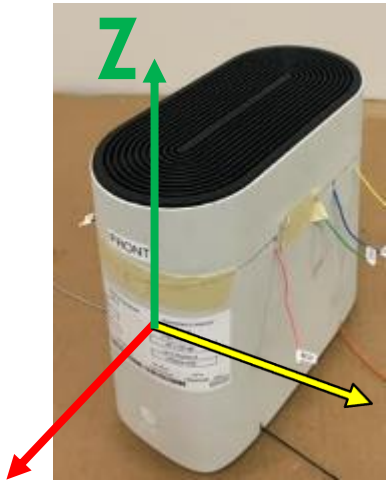


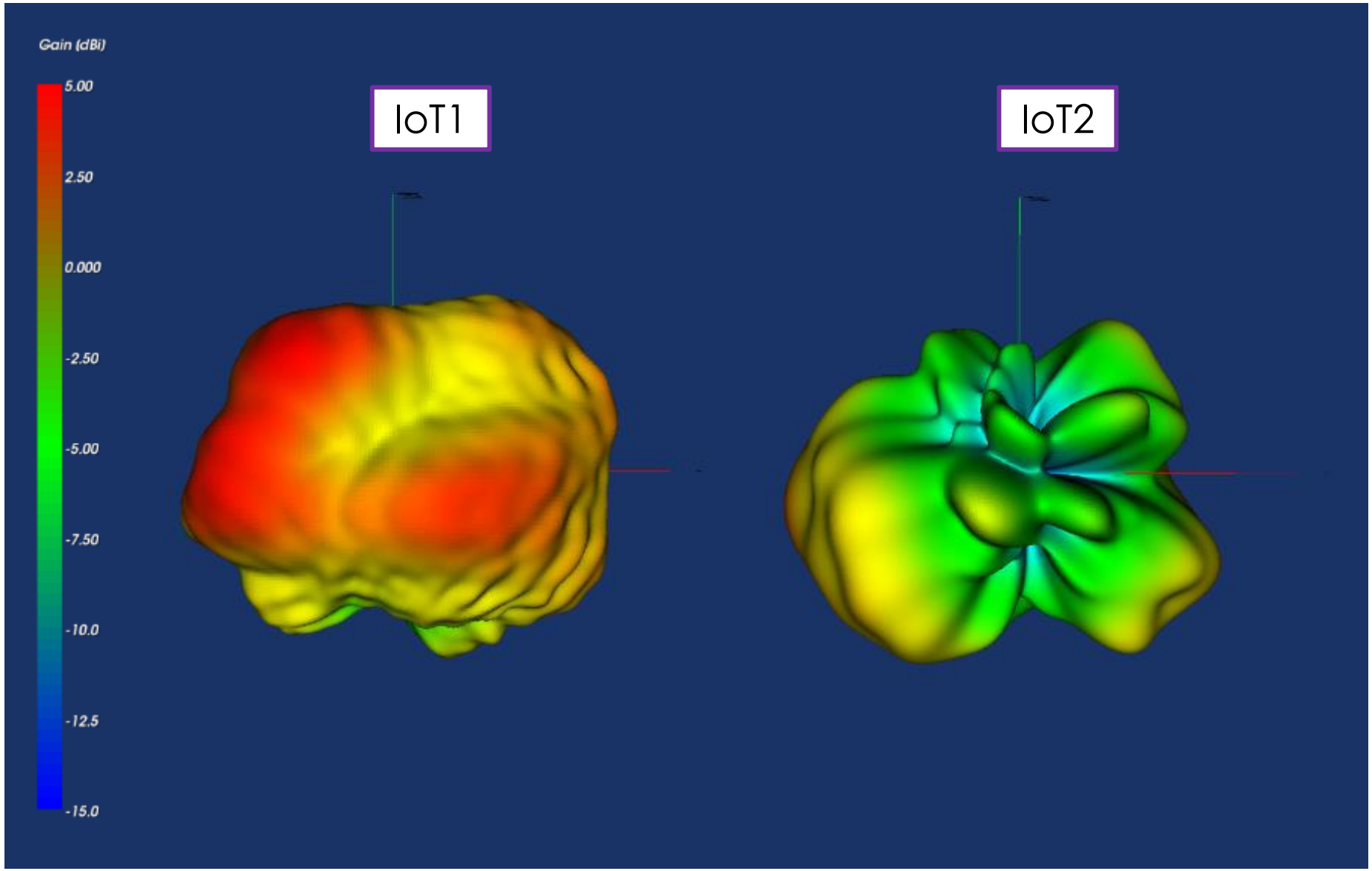


3D Gain Plot – IoT Antennas – 2.45 GHz

Front-to-Back

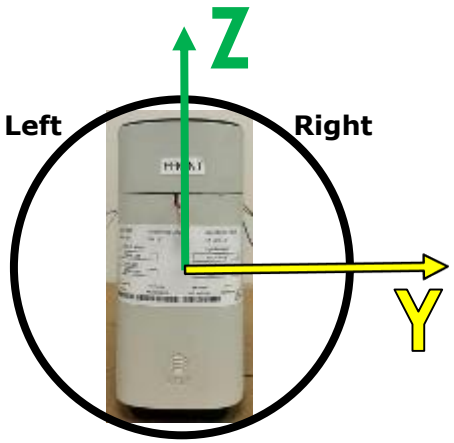


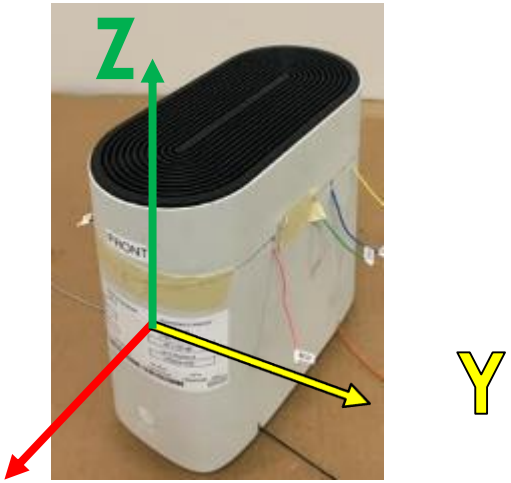


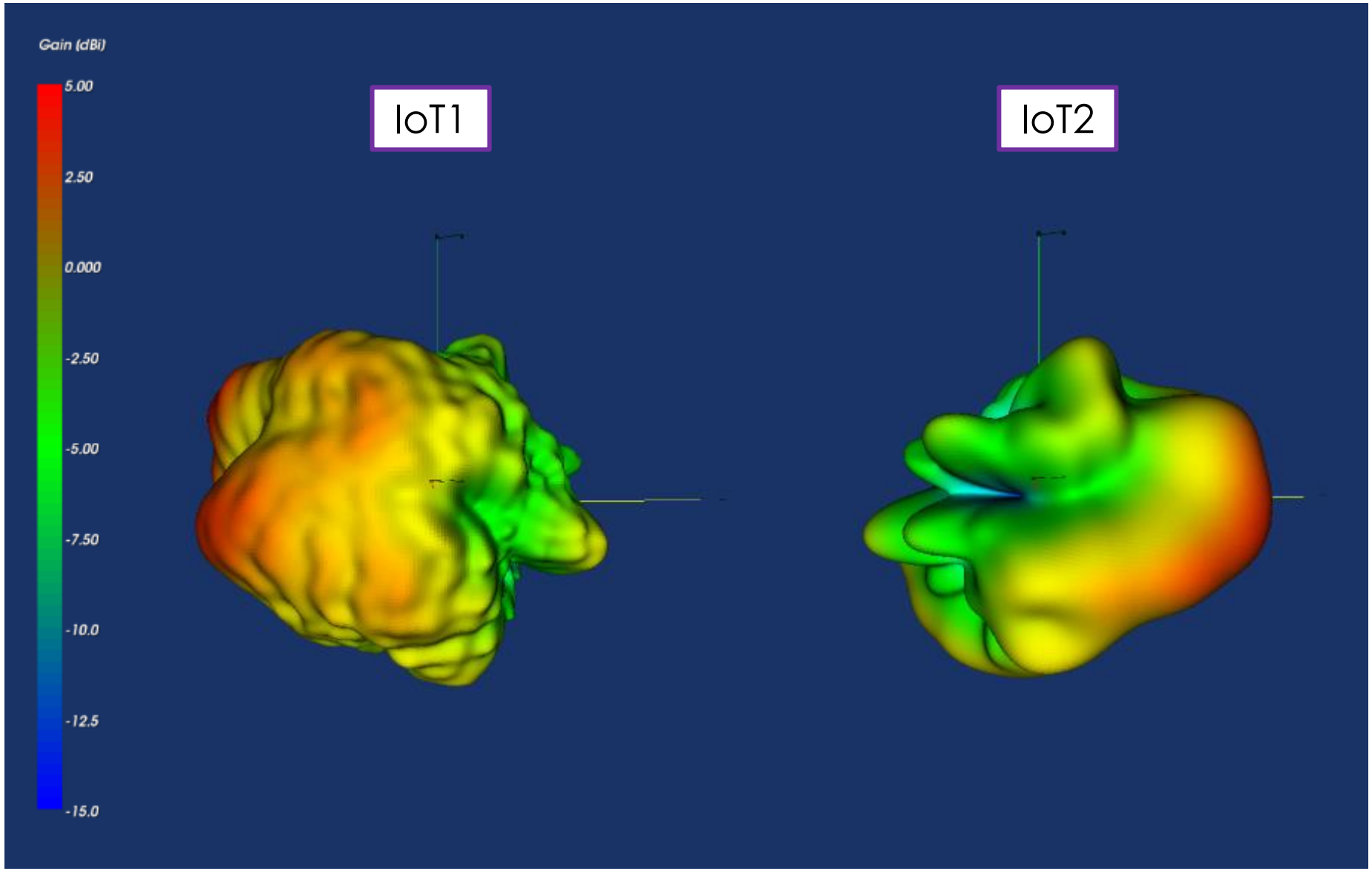


3D Gain Plot – IoT Antennas – 2.45 GHz

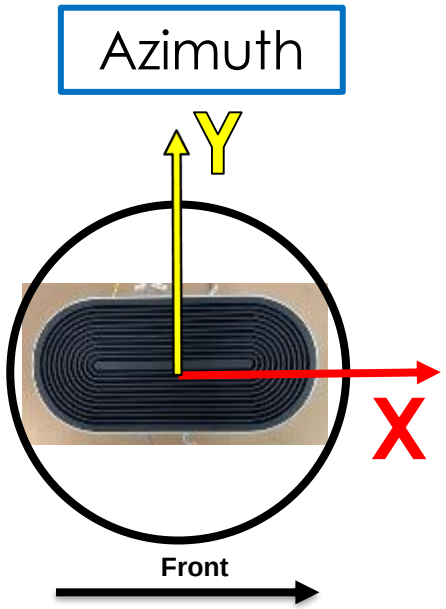
Side-to-Side

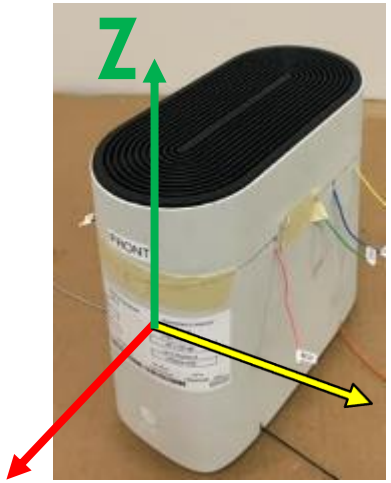


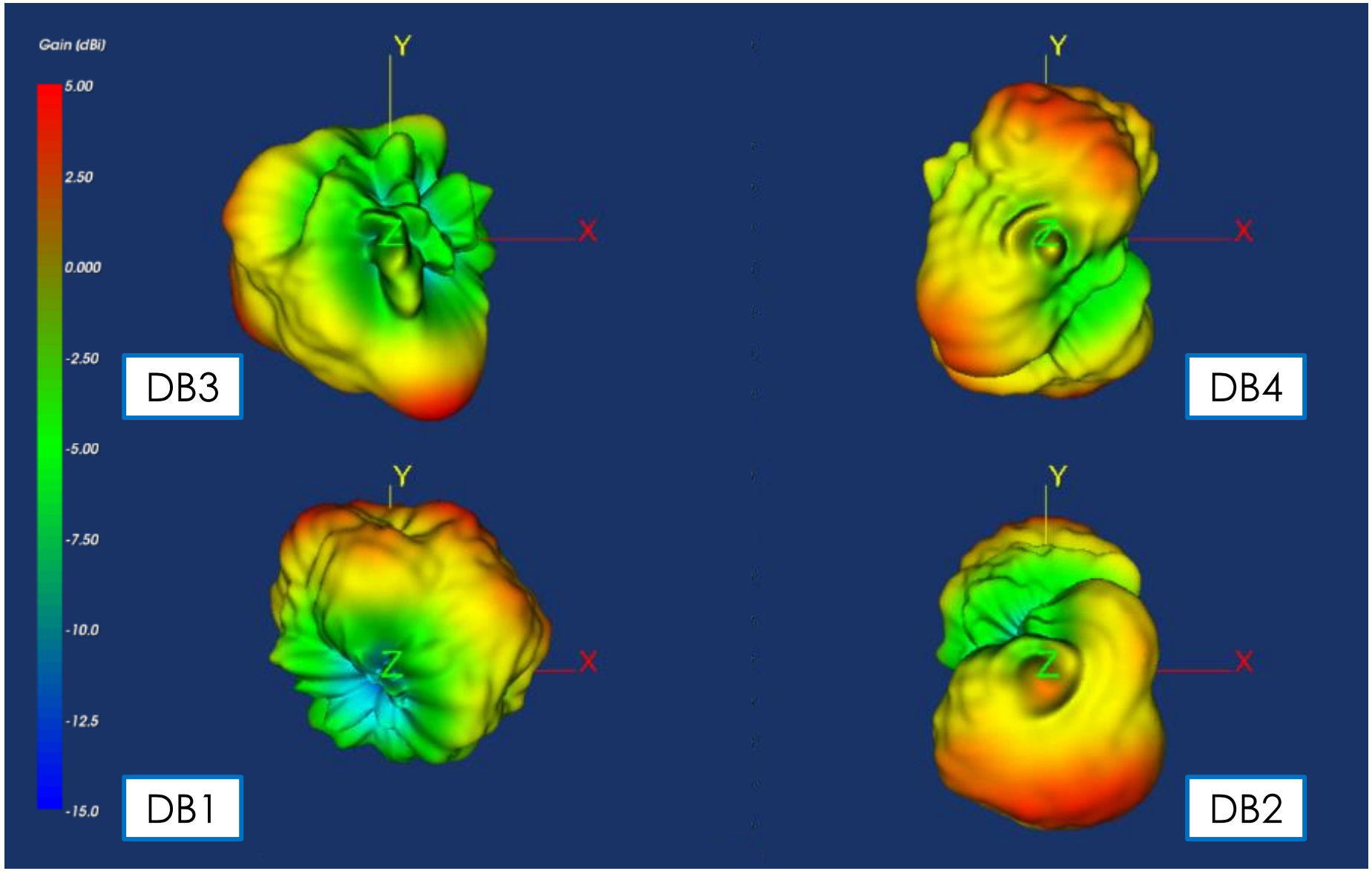




3D Gain Plot – DB Antennas – 2.45 GHz

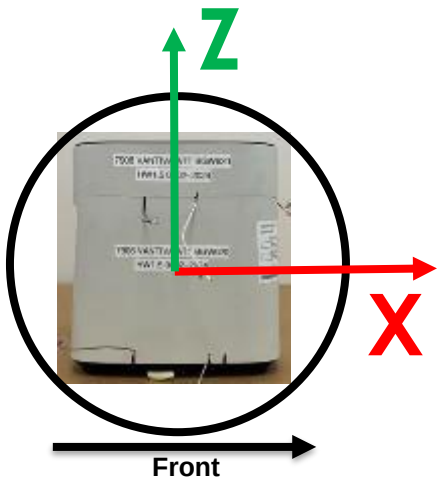


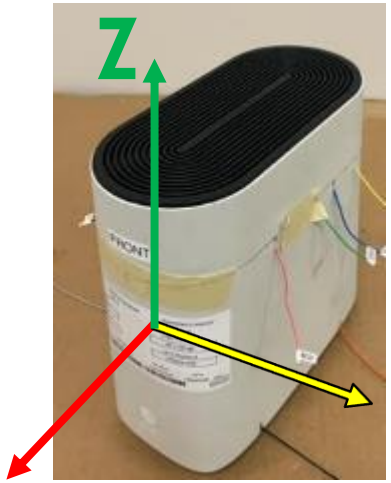


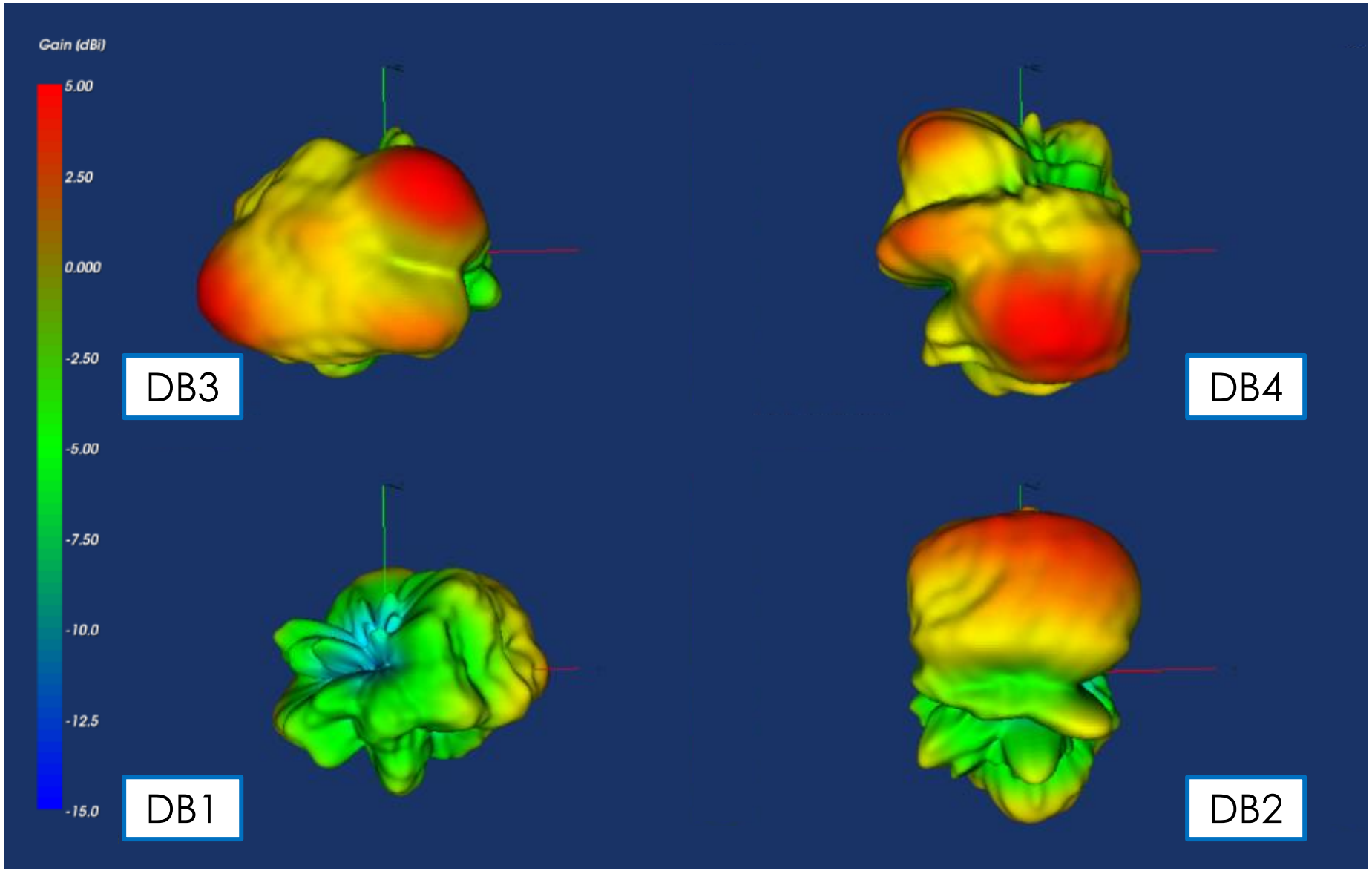


3D Gain Plot – DB Antennas – 2.45 GHz

Front-to-Back

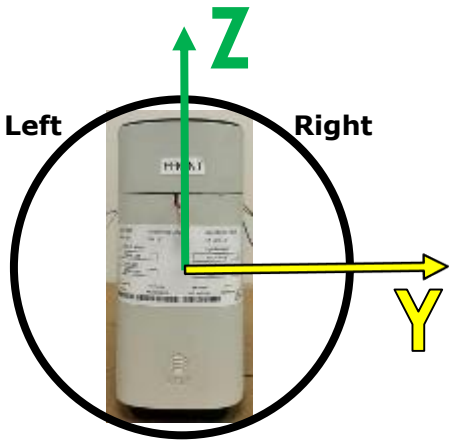


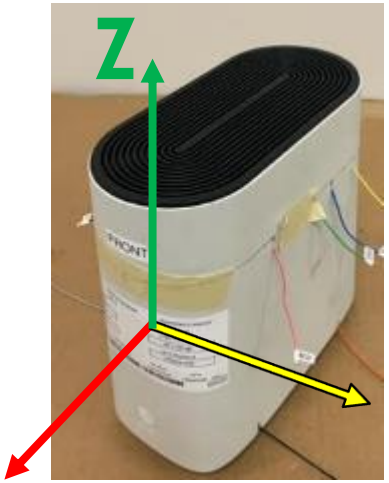


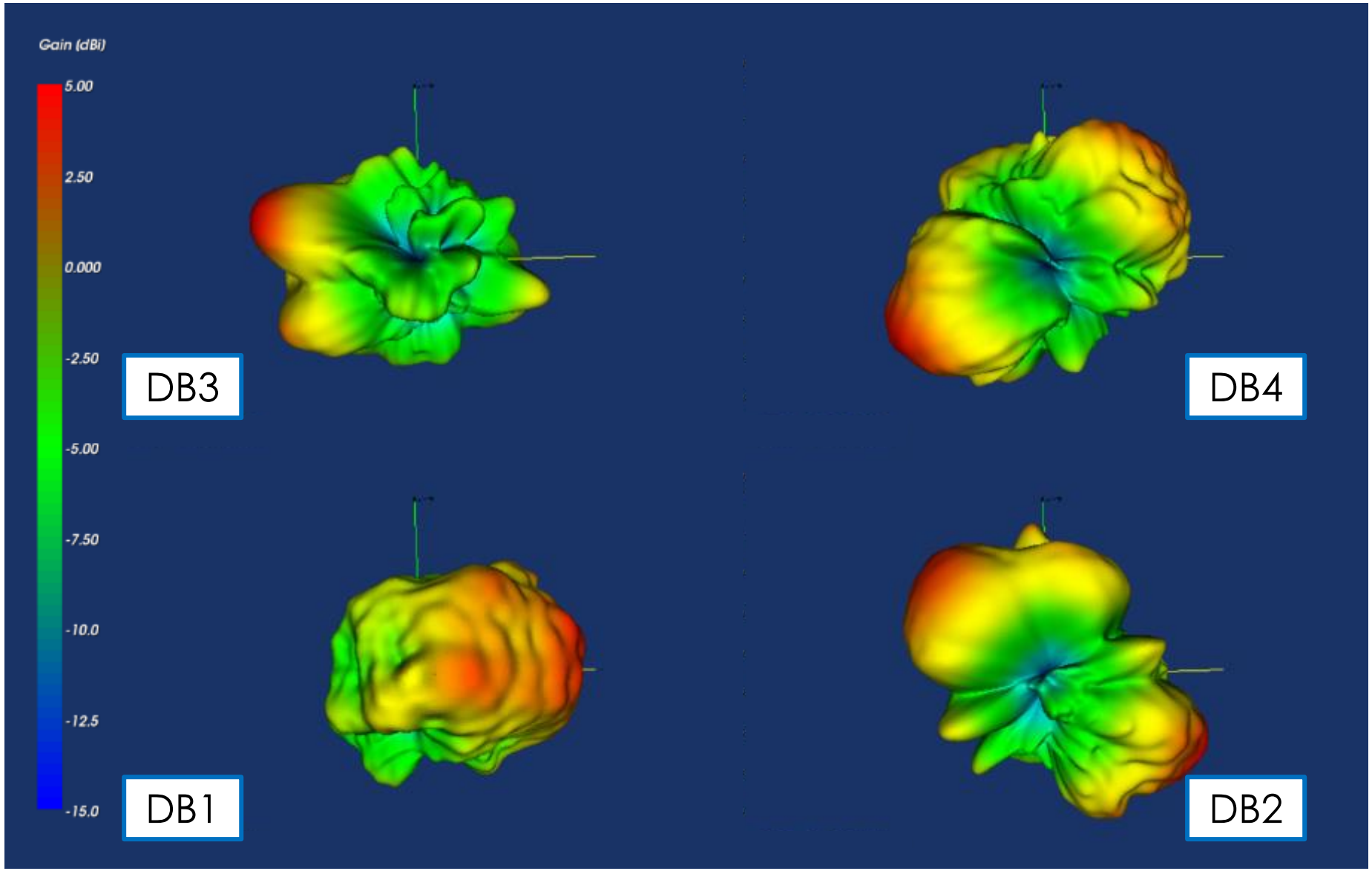


3D Gain Plot – DB Antennas – 2.45 GHz

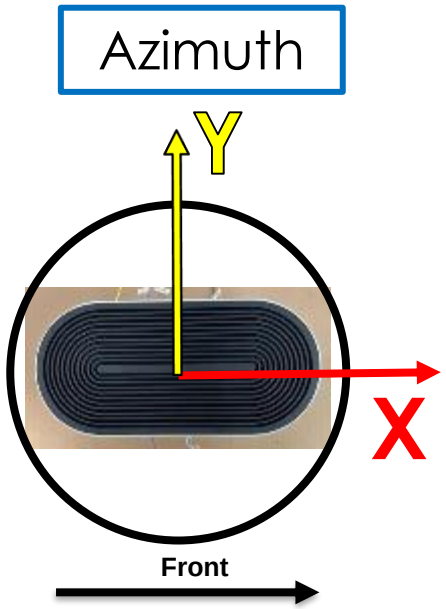
Side-to-Side

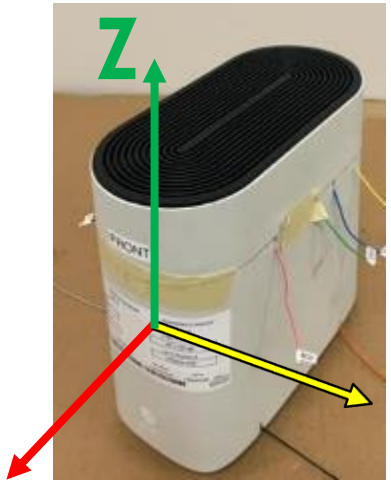


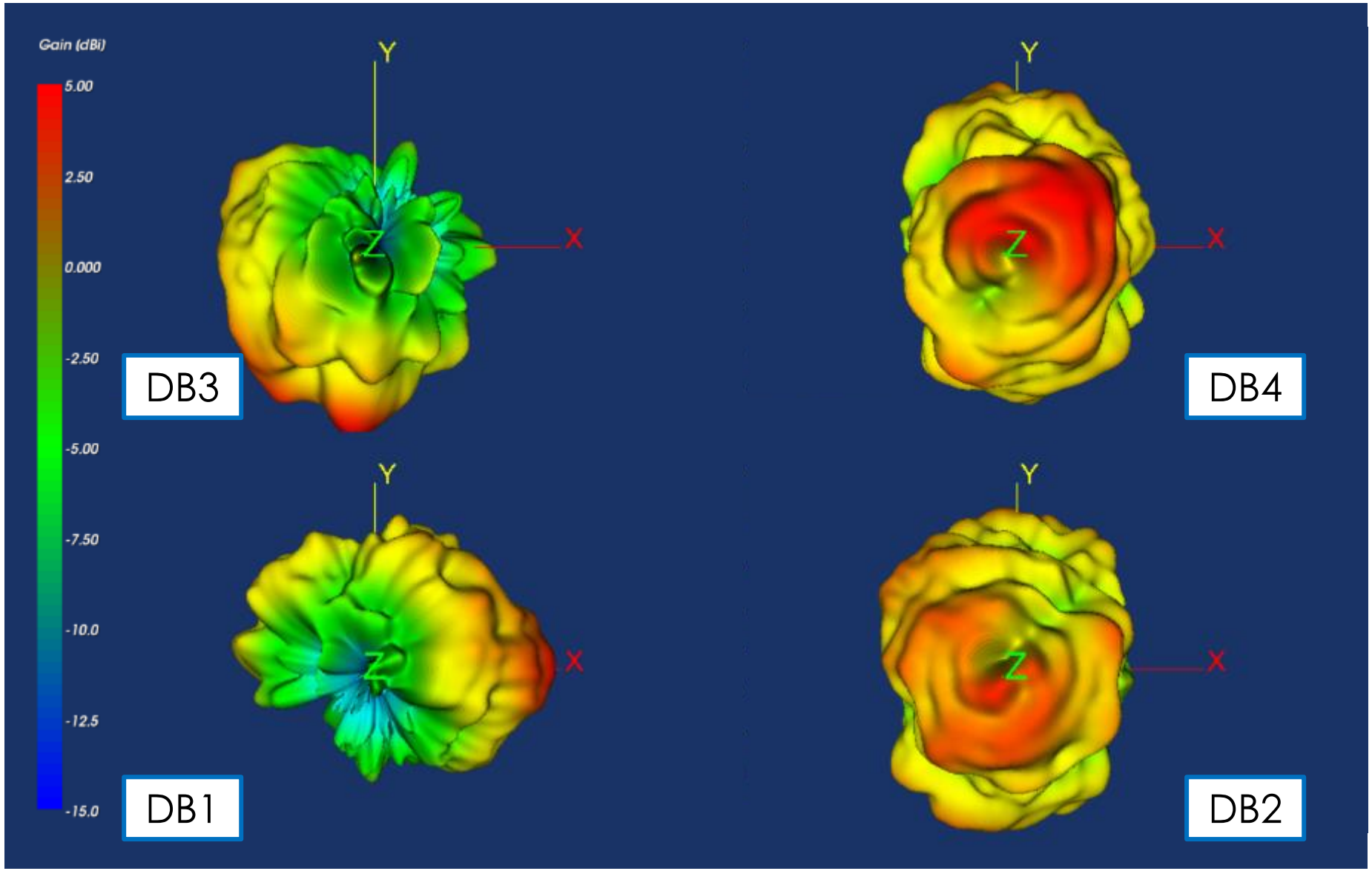




3D Gain Plot – DB Antennas – 5.25 GHz

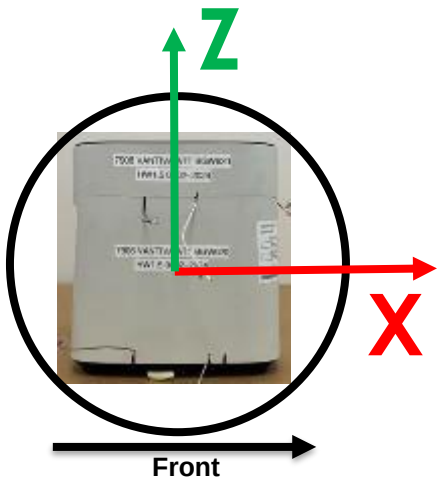


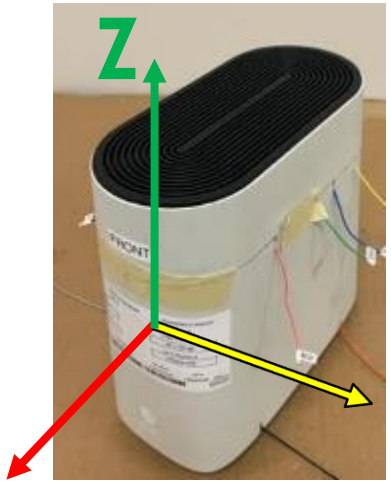


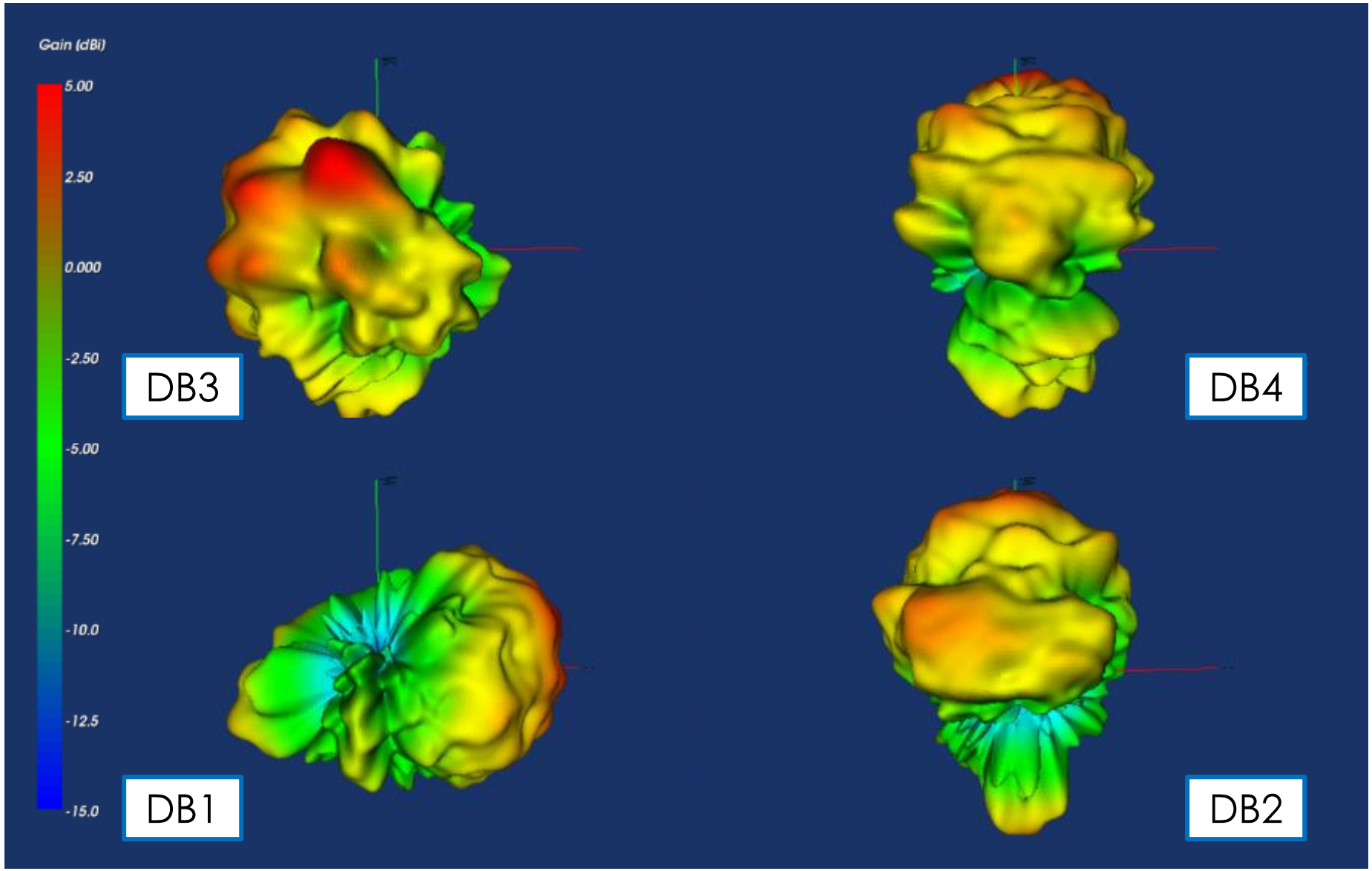


3D Gain Plot – DB Antennas – 5.25 GHz

Front-to-Back

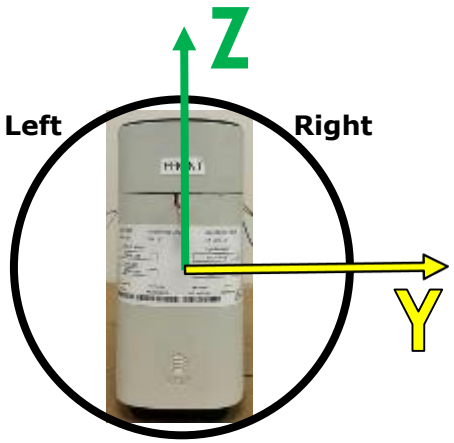


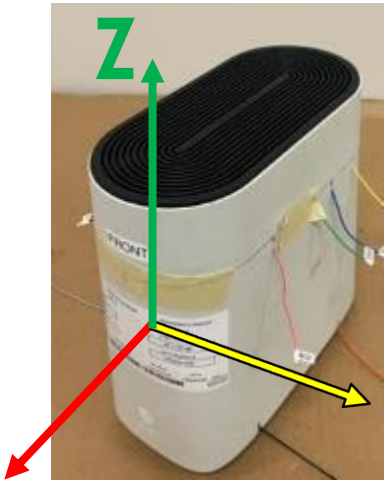


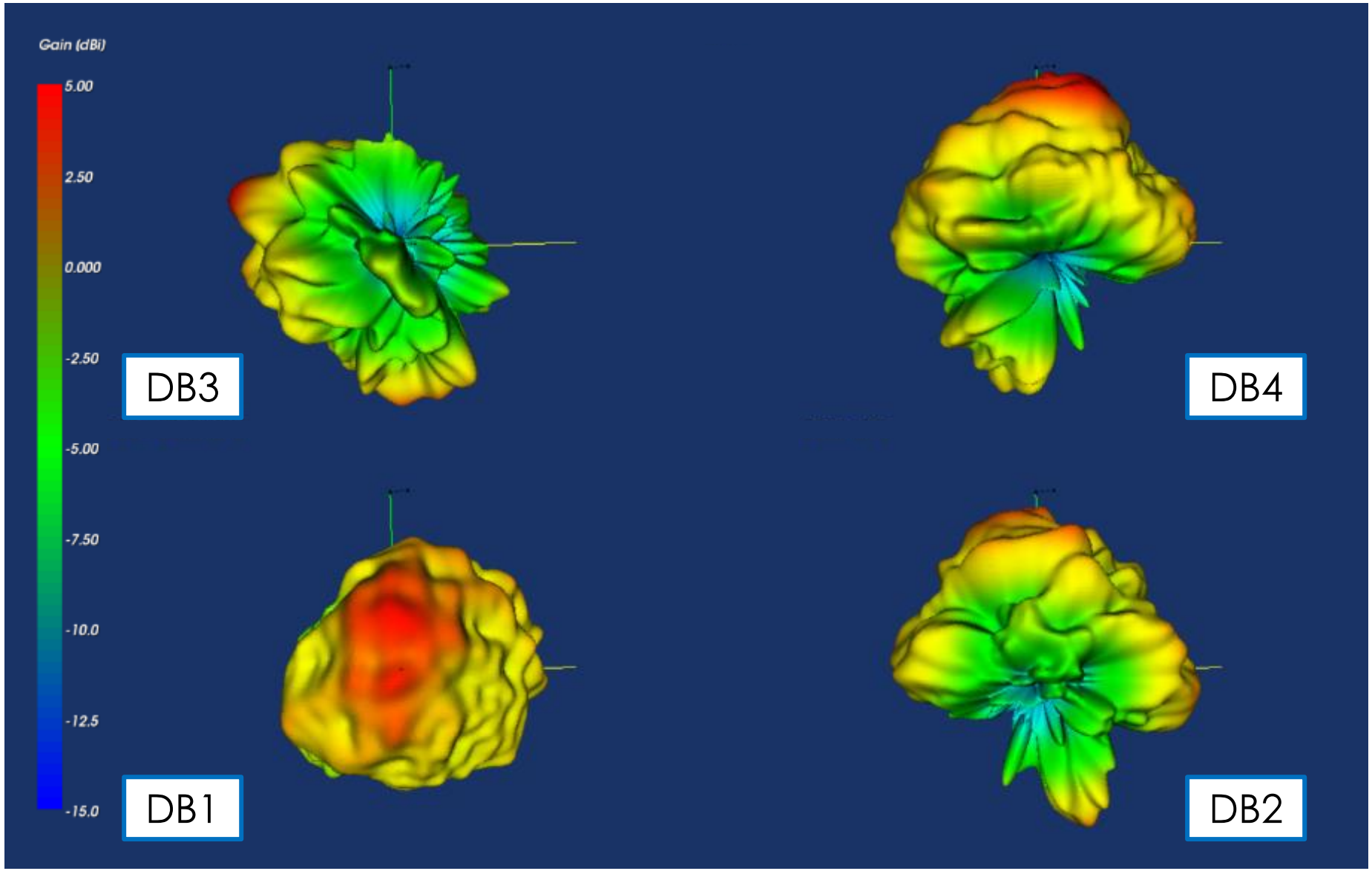


3D Gain Plot – DB Antennas – 5.25 GHz

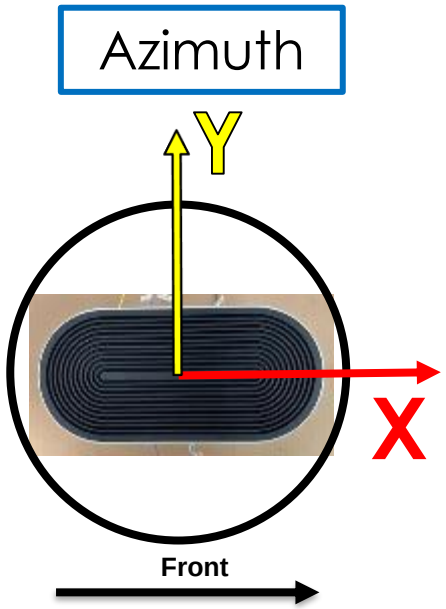
Side-to-Side

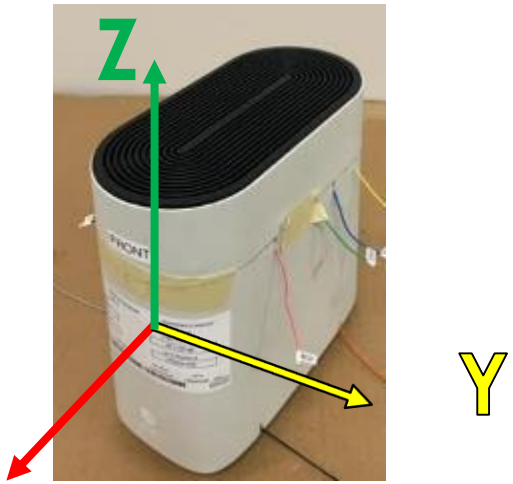


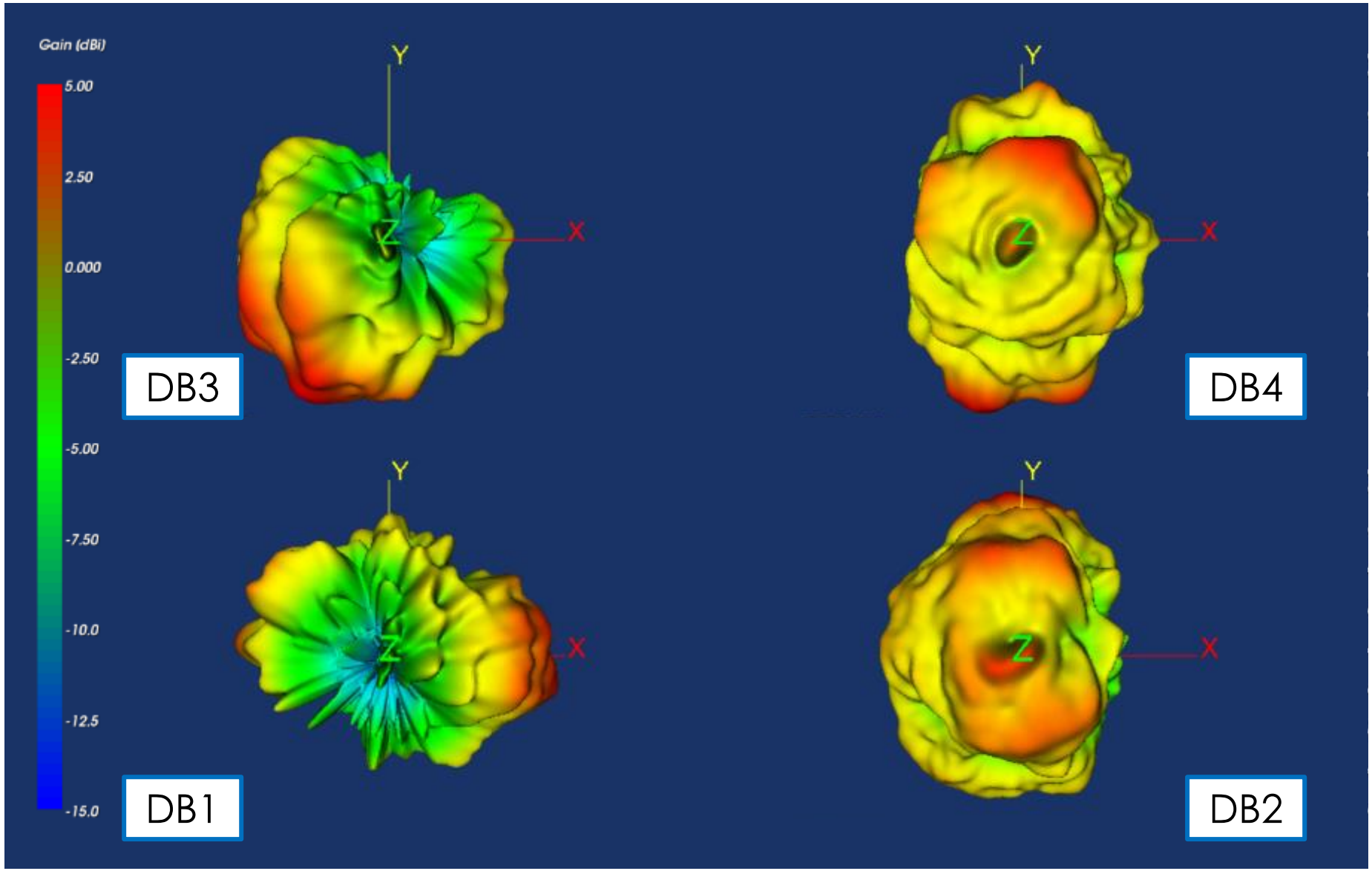




3D Gain Plot – DB Antennas – 5.725 GHz

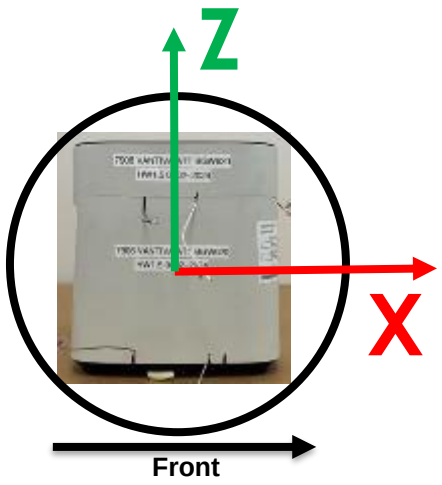


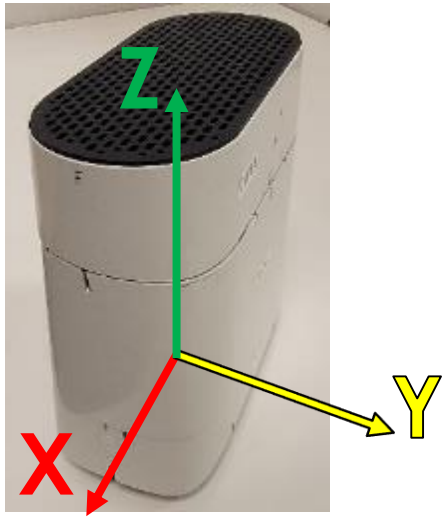


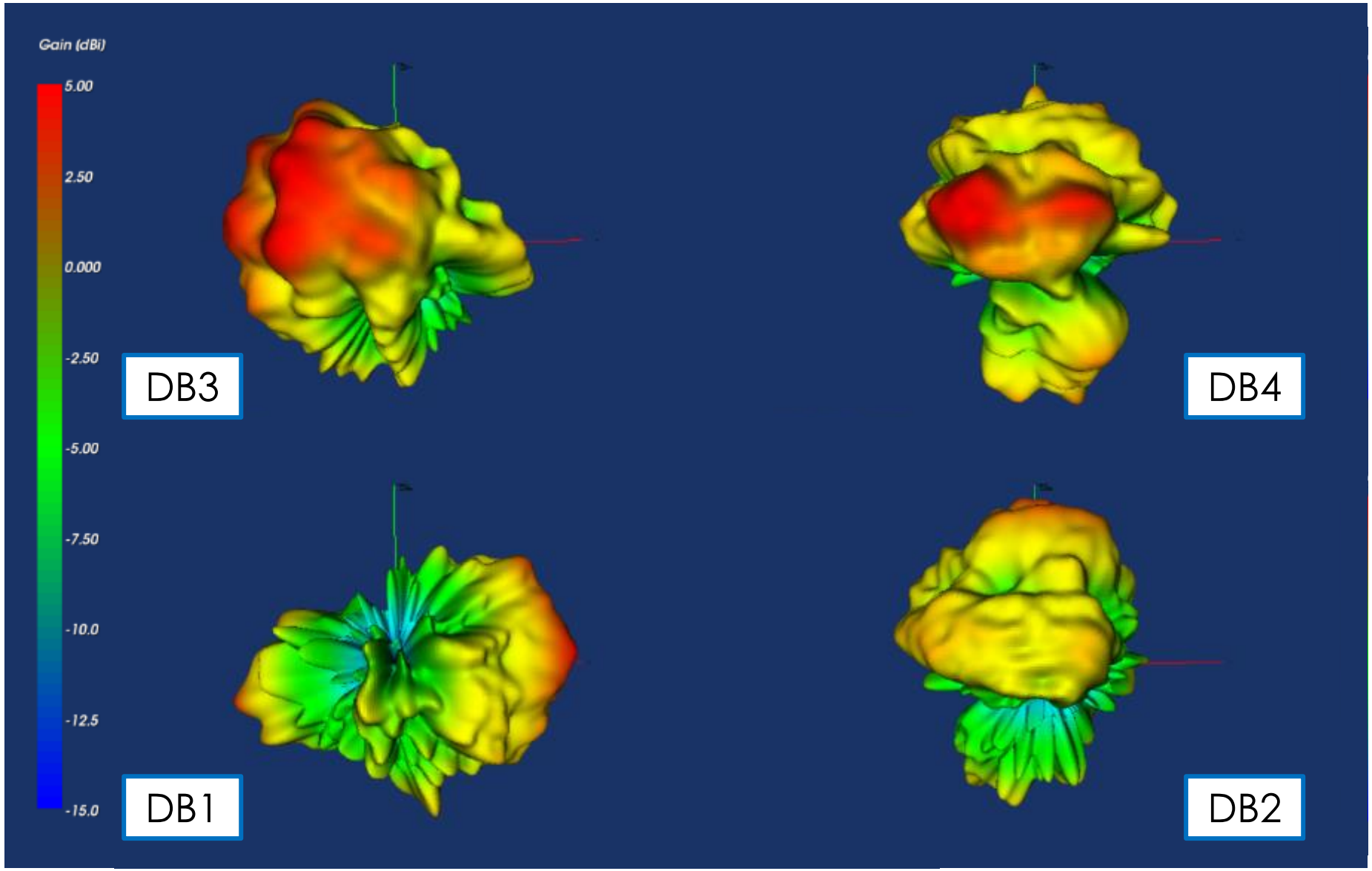


3D Gain Plot – DB Antennas – 5.725 GHz

Front-to-Back

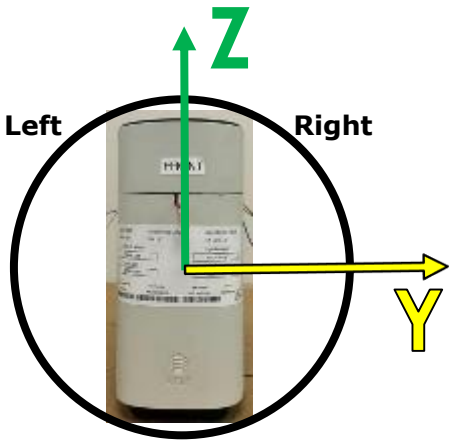


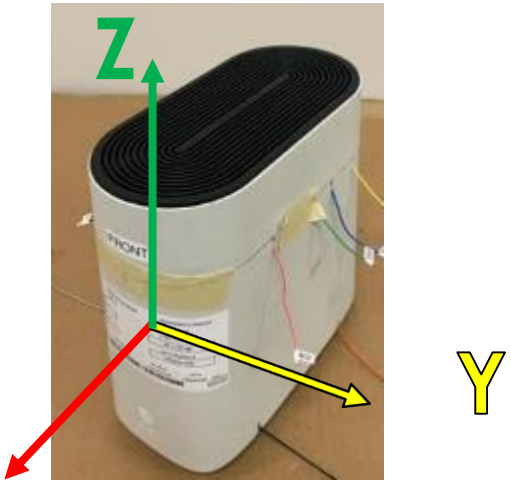


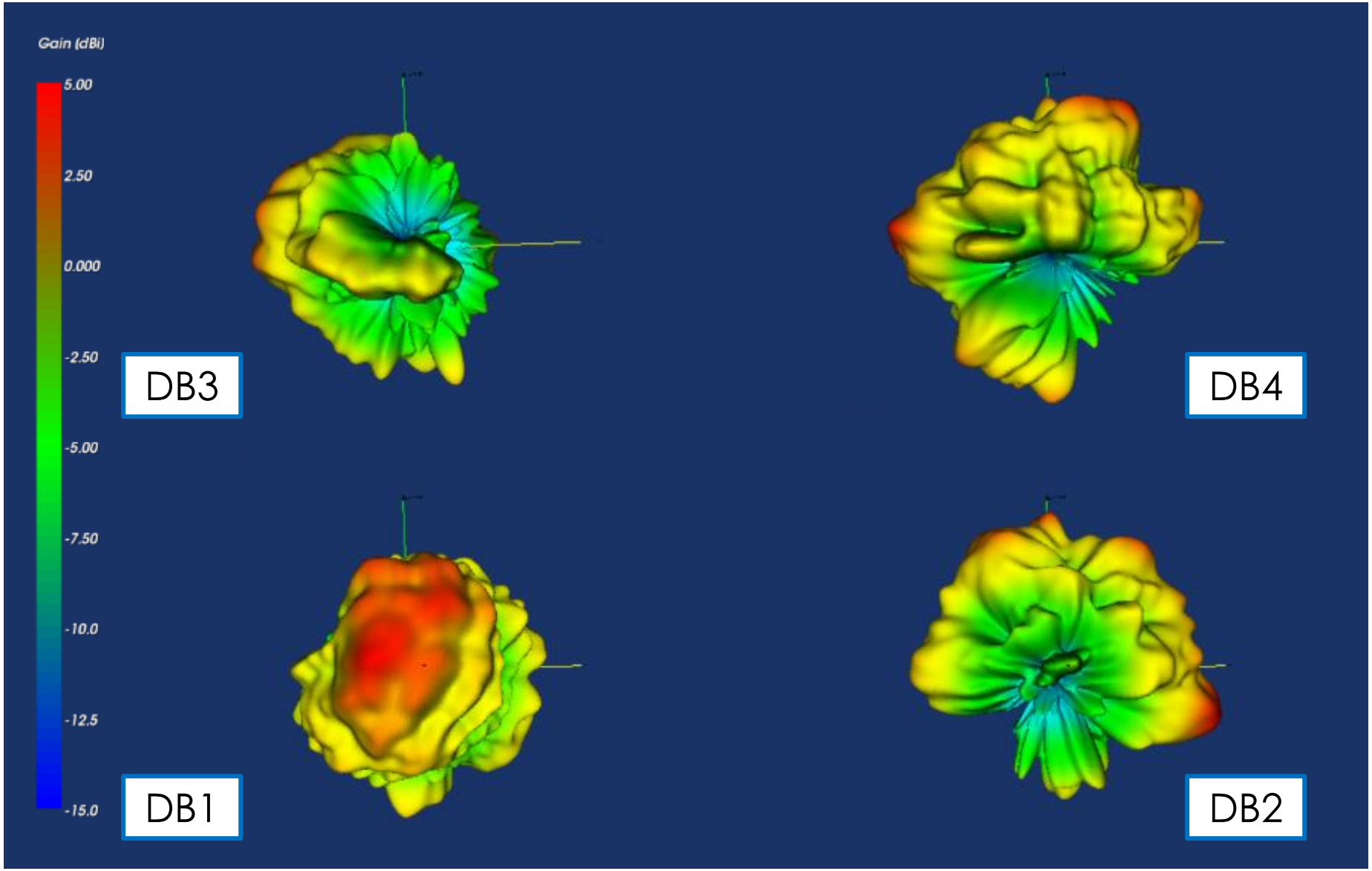


3D Gain Plot – DB Antennas – 5.725 GHz

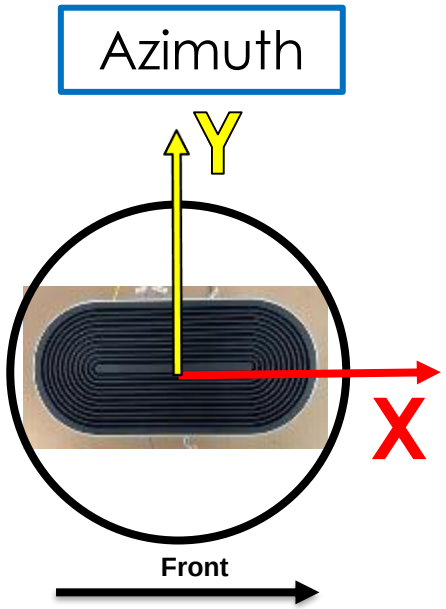
Side-to-Side

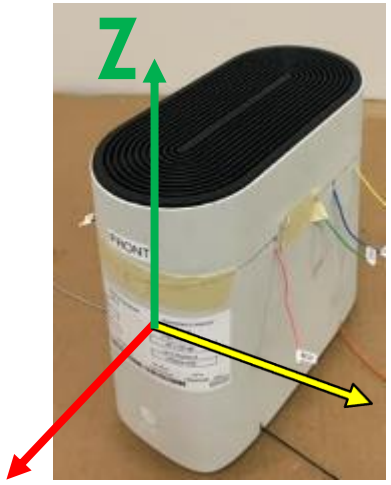


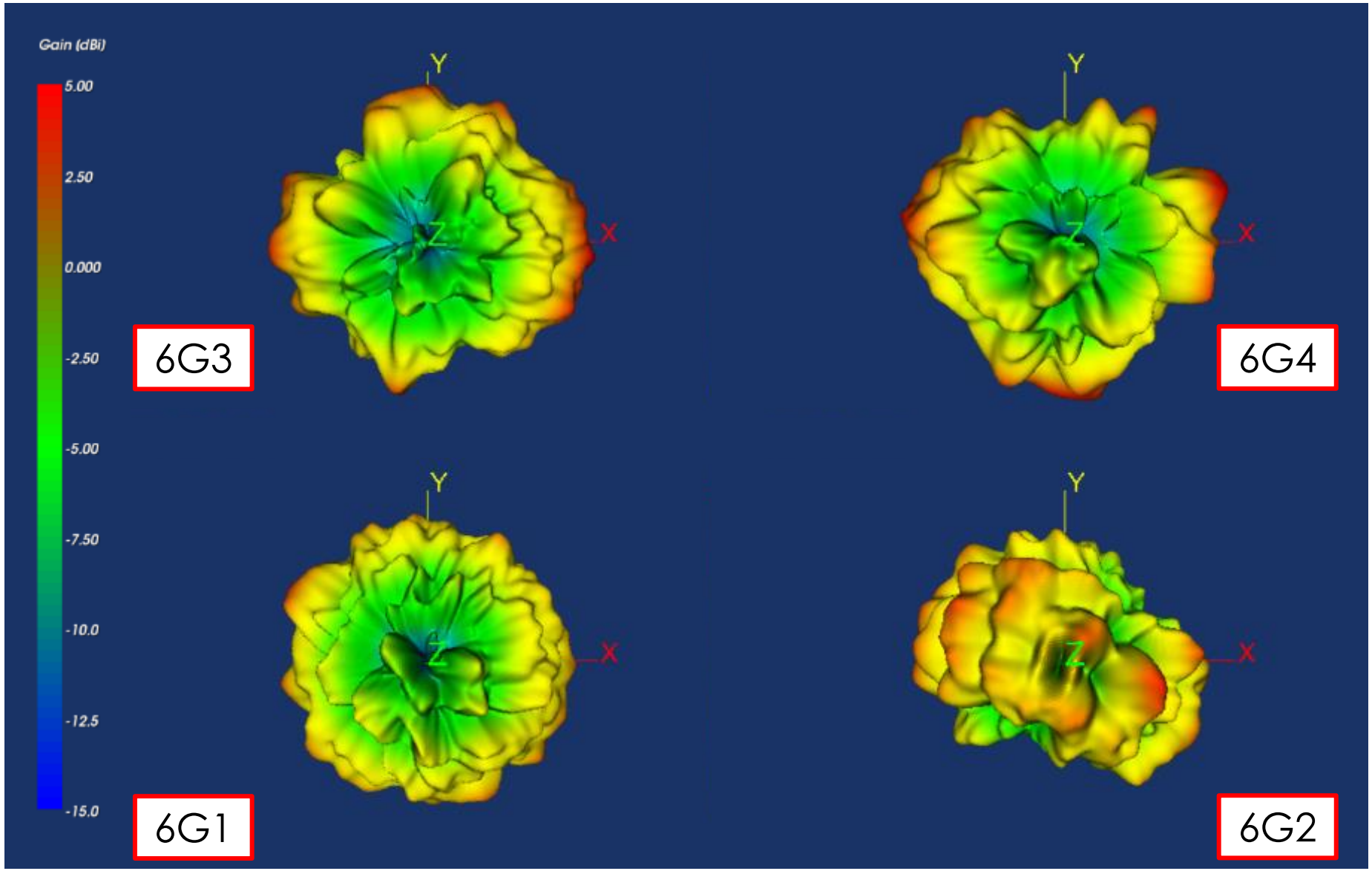




3D Gain Plot – 6 GHz Antennas – 5.925 GHz

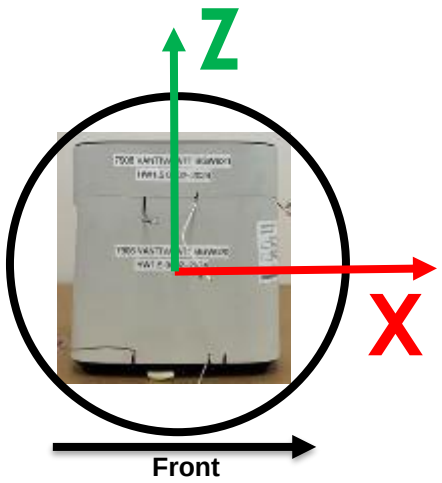


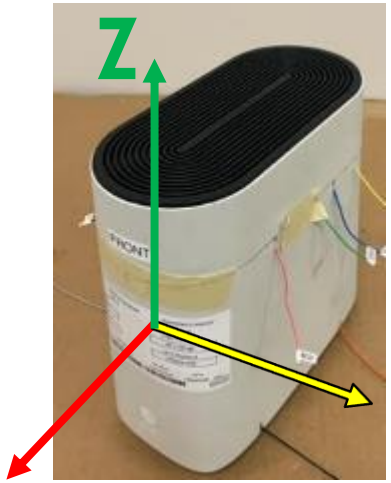


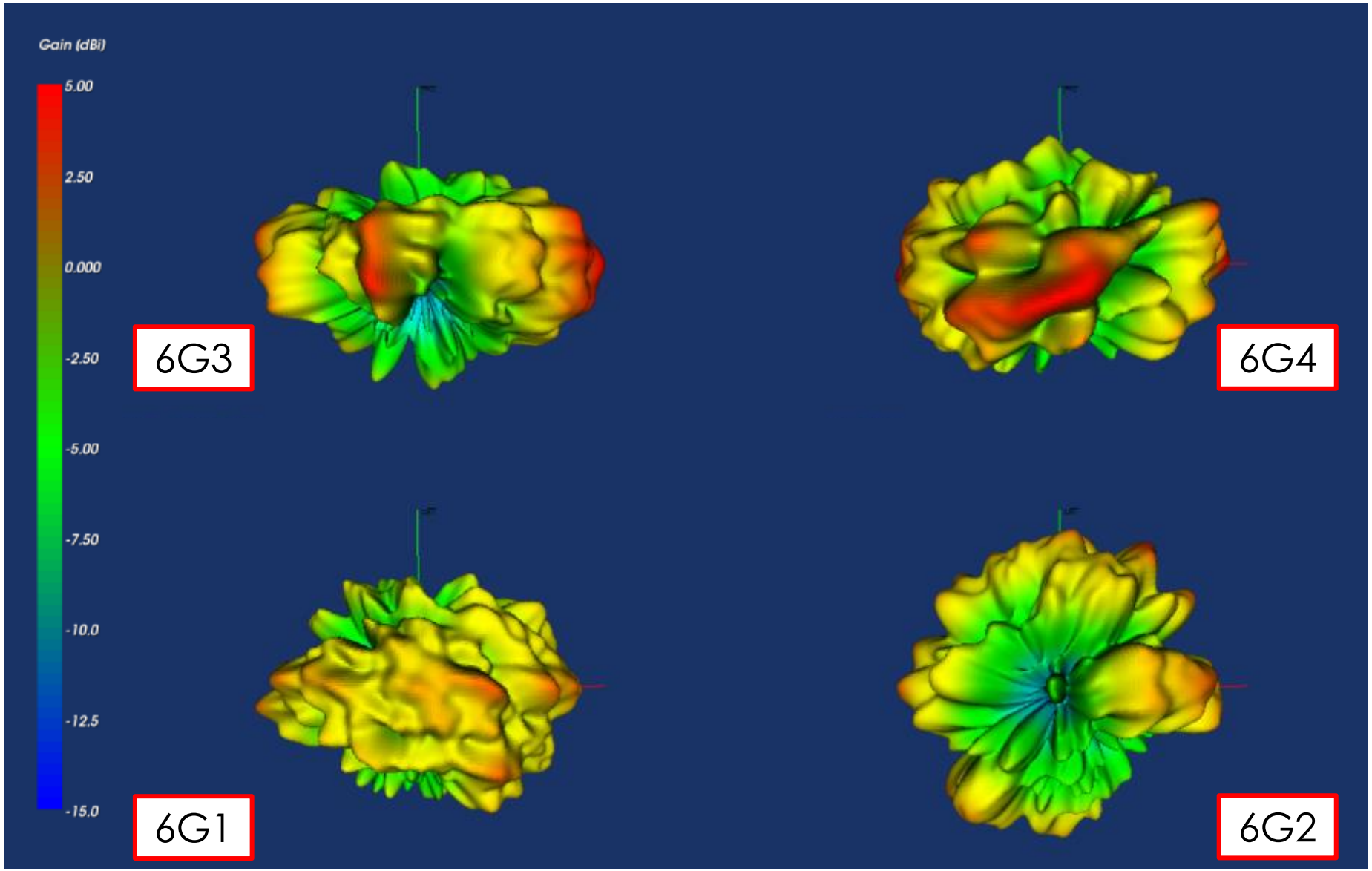


3D Gain Plot – 6 GHz Antennas – 5.925 GHz

Front-to-Back

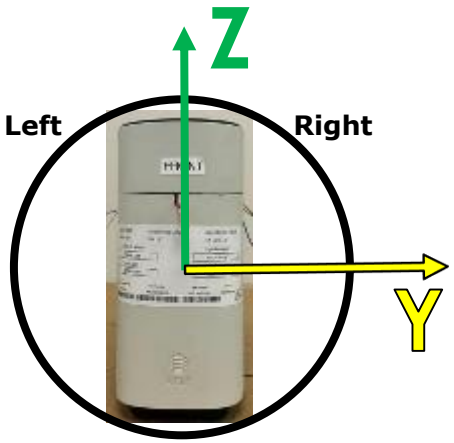


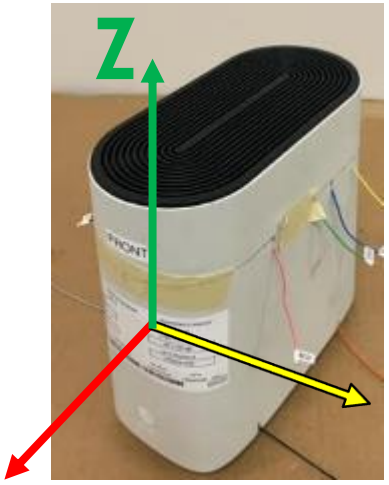


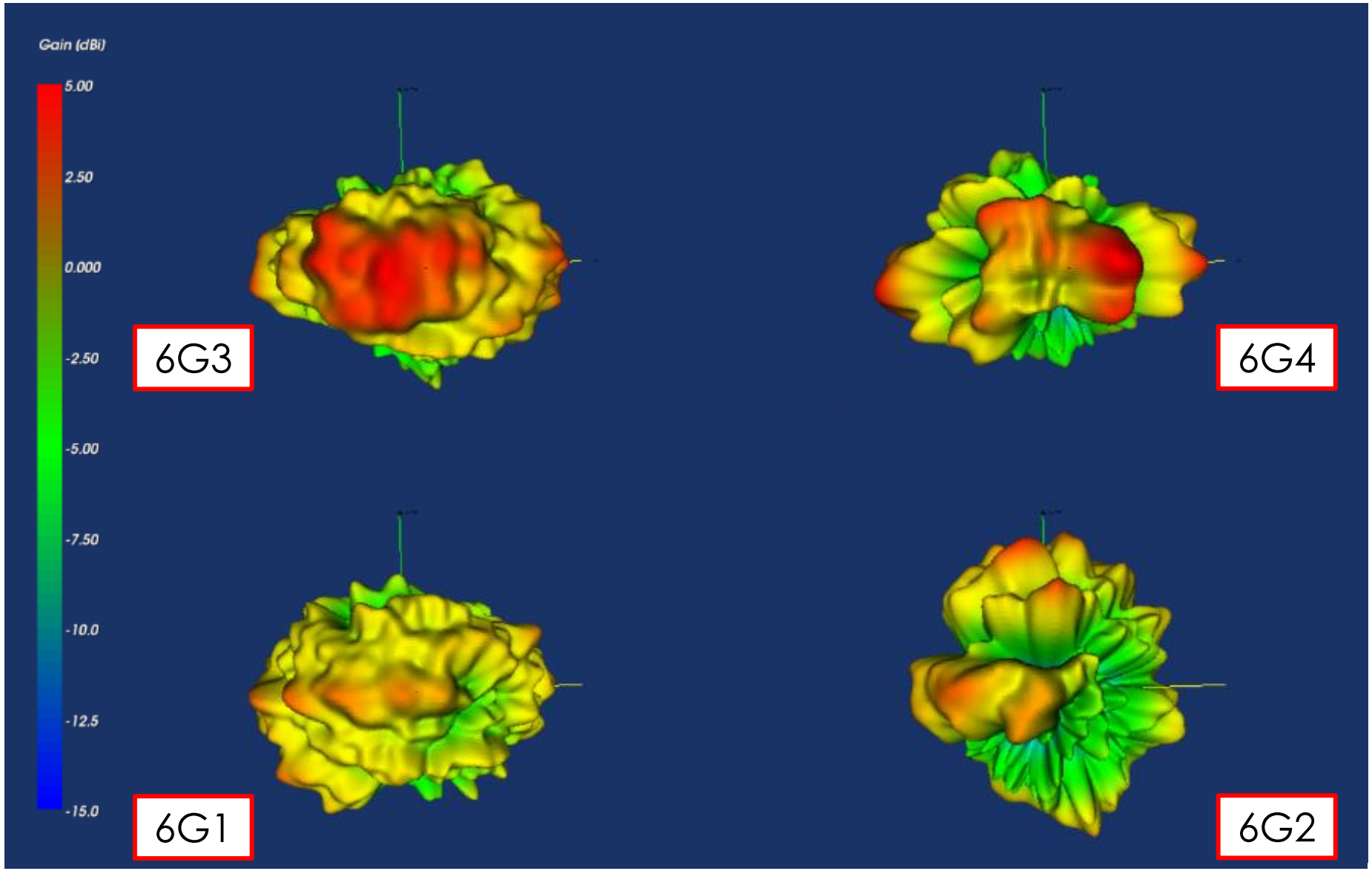


3D Gain Plot – 6 GHz Antennas – 5.925 GHz

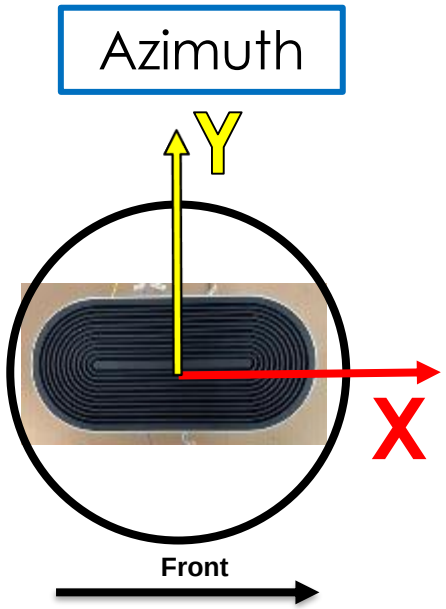
Side-to-Side

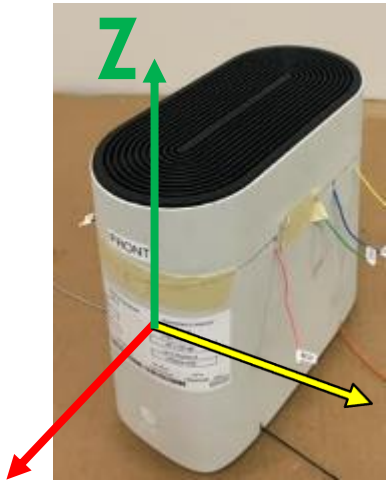


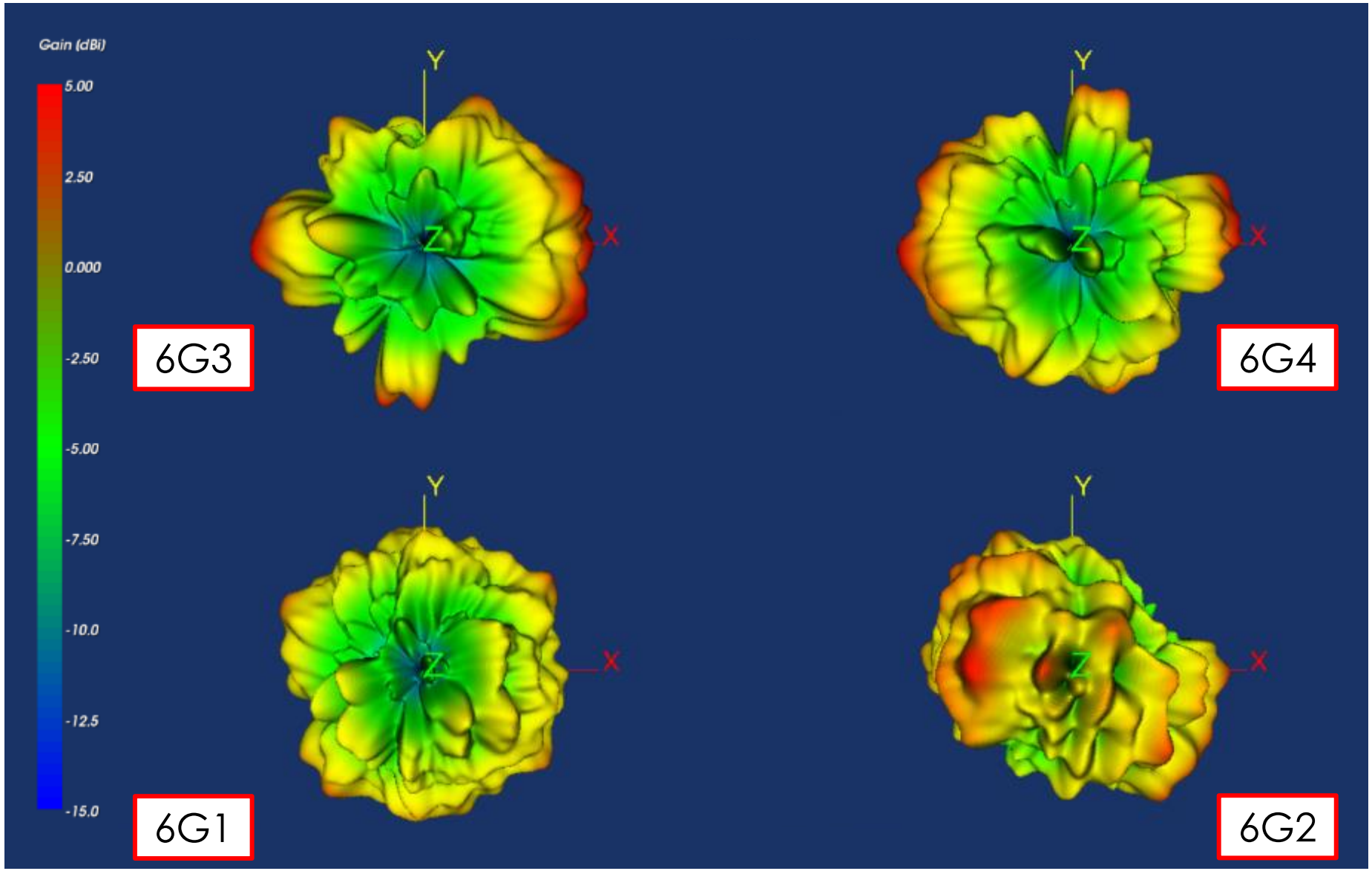




3D Gain Plot – 6 GHz Antennas – 6.5 GHz

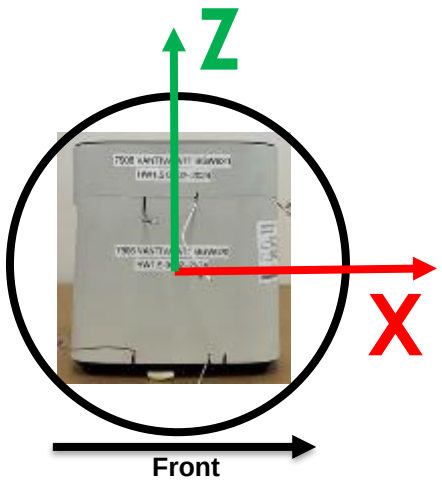


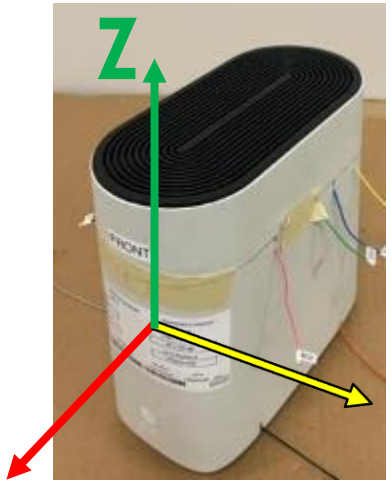


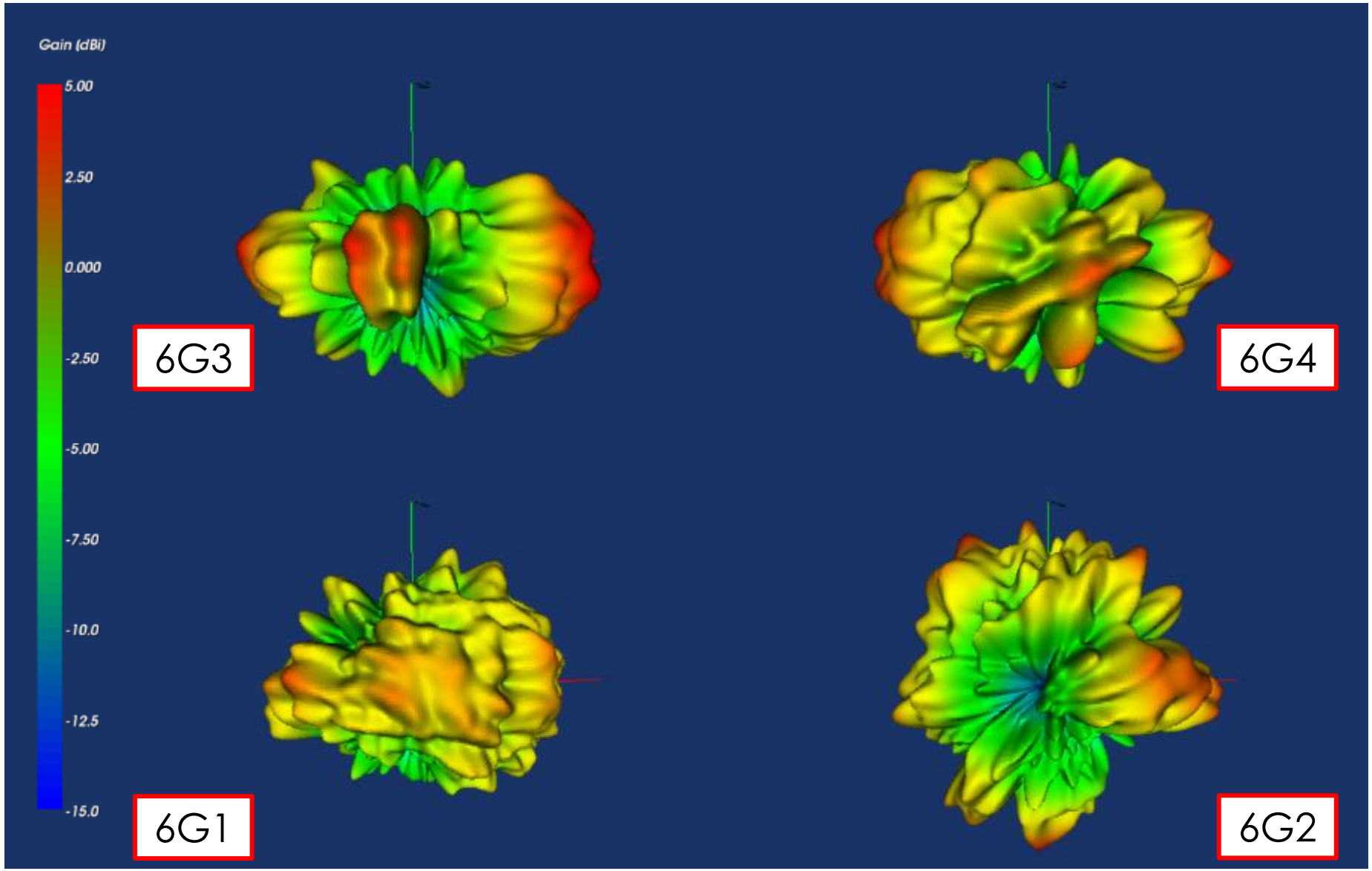


3D Gain Plot – 6 GHz Antennas – 6.5 GHz

Front-to-Back

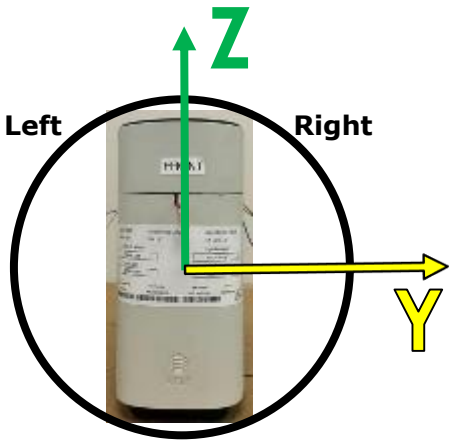


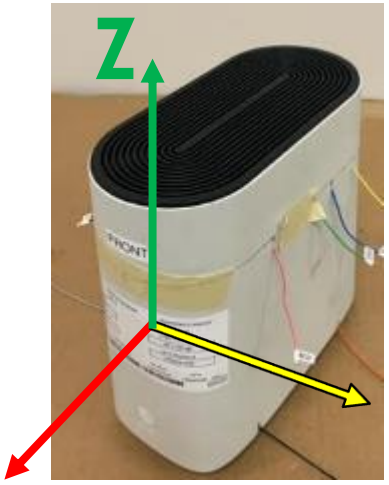


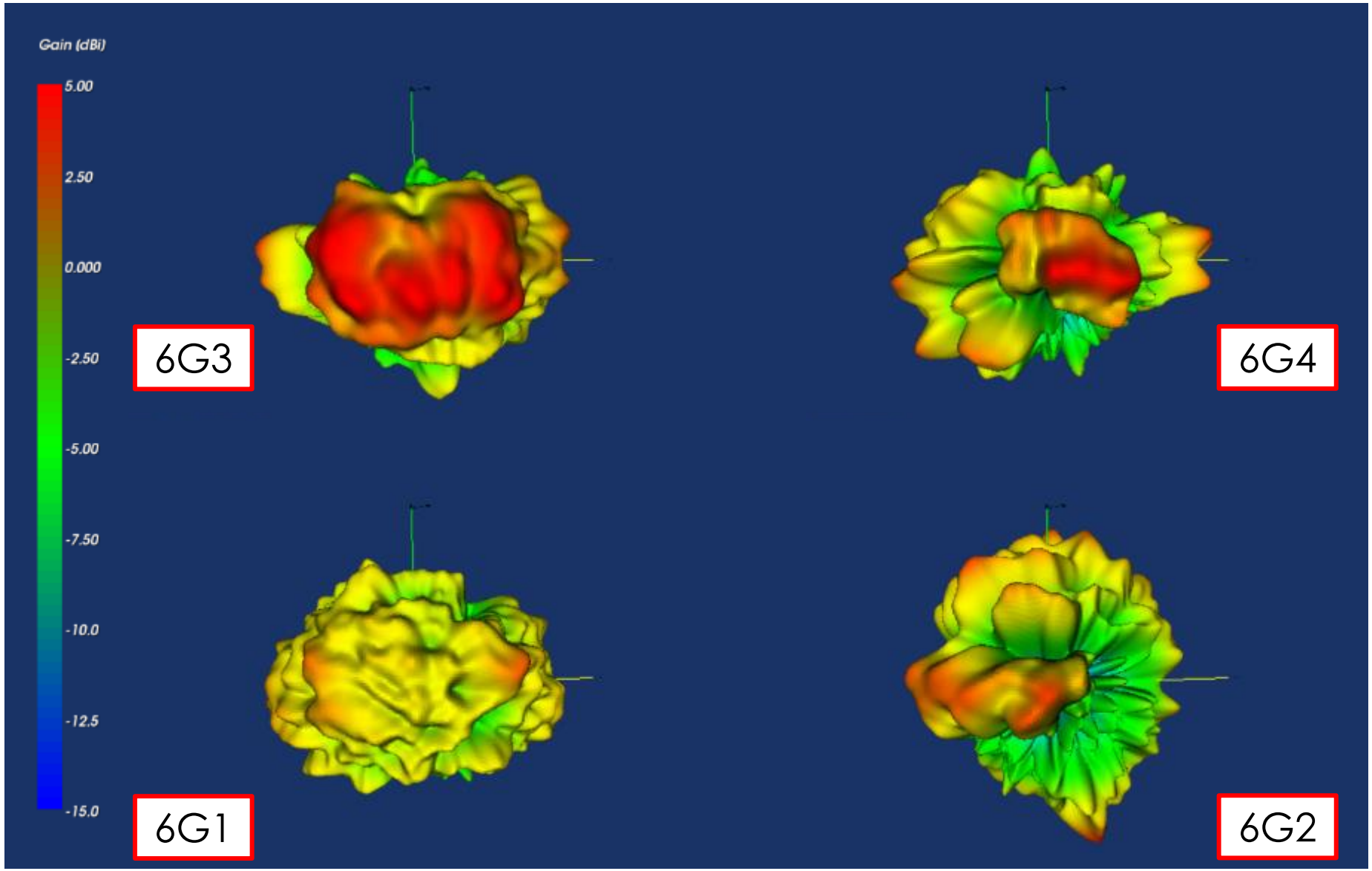


3D Gain Plot – 6 GHz Antennas – 6.5 GHz

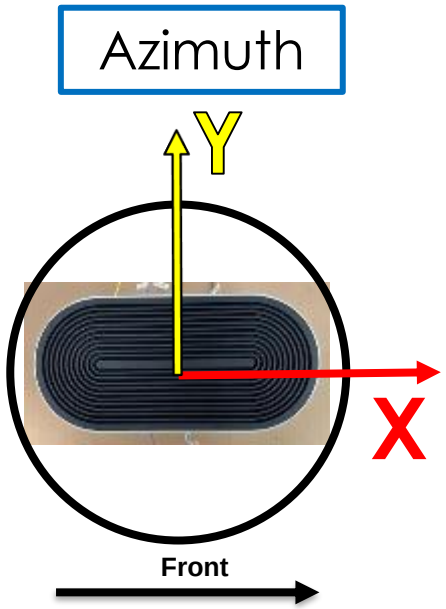
Side-to-Side

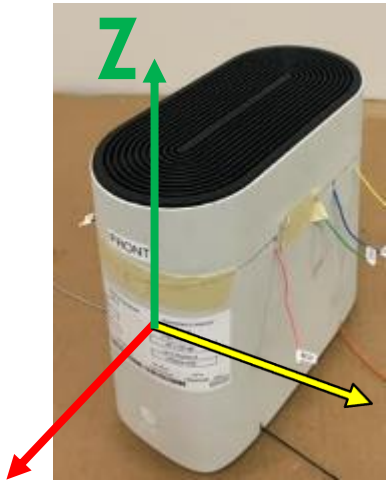


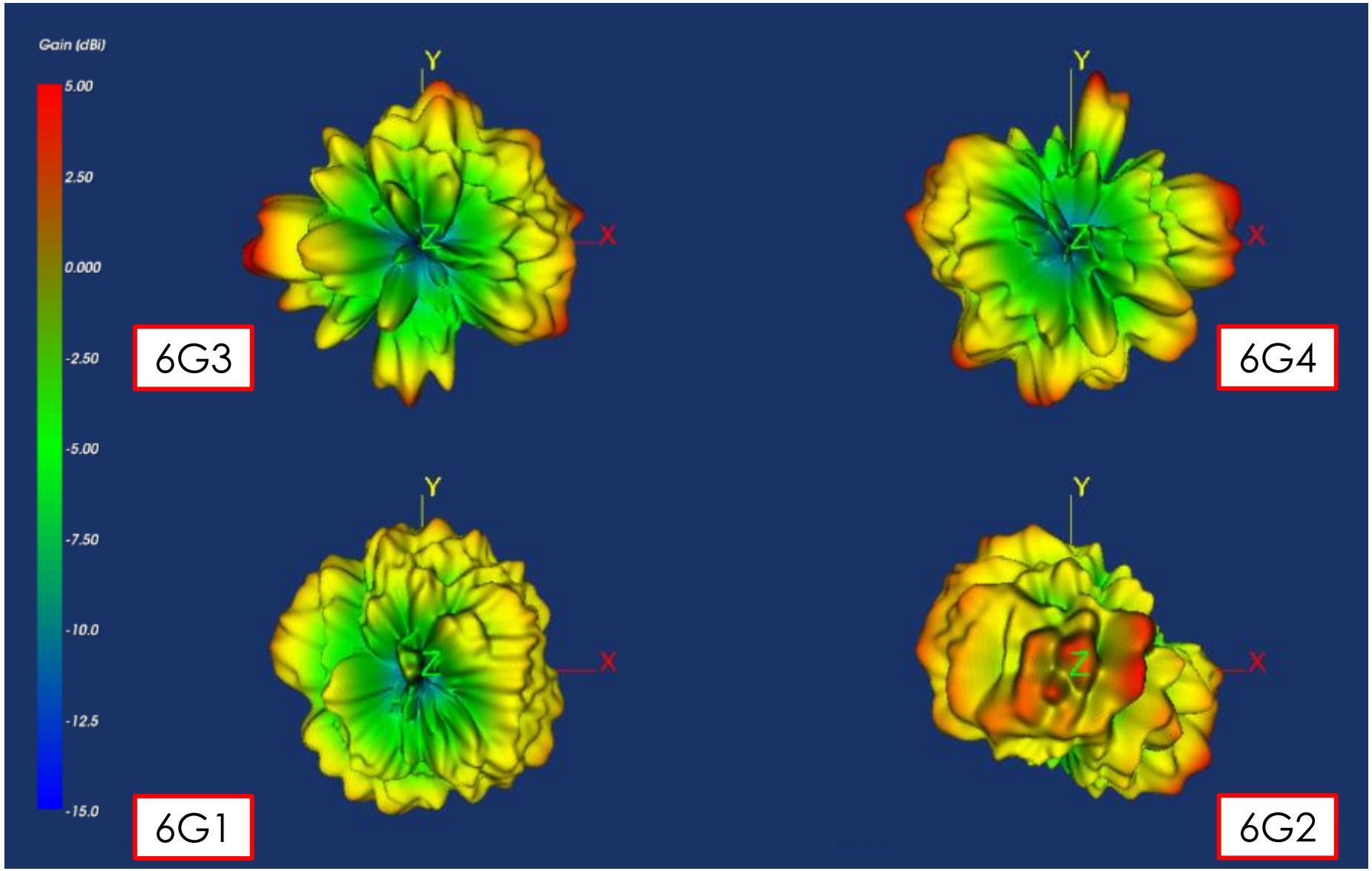




3D Gain Plot – 6 GHz Antennas – 7.125 GHz

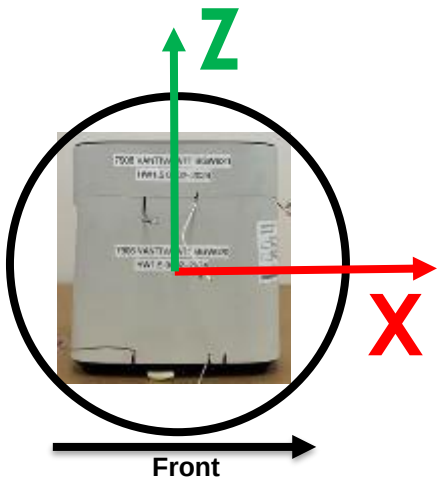


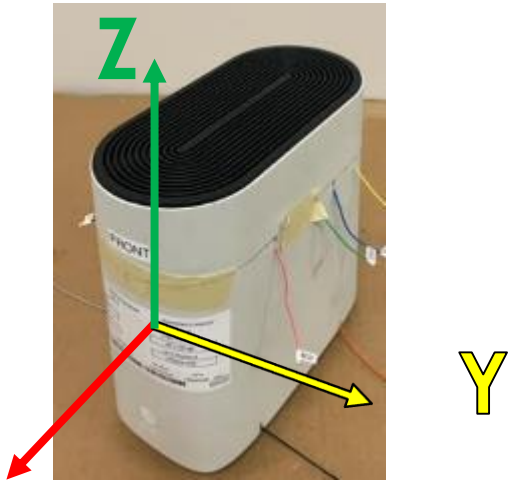


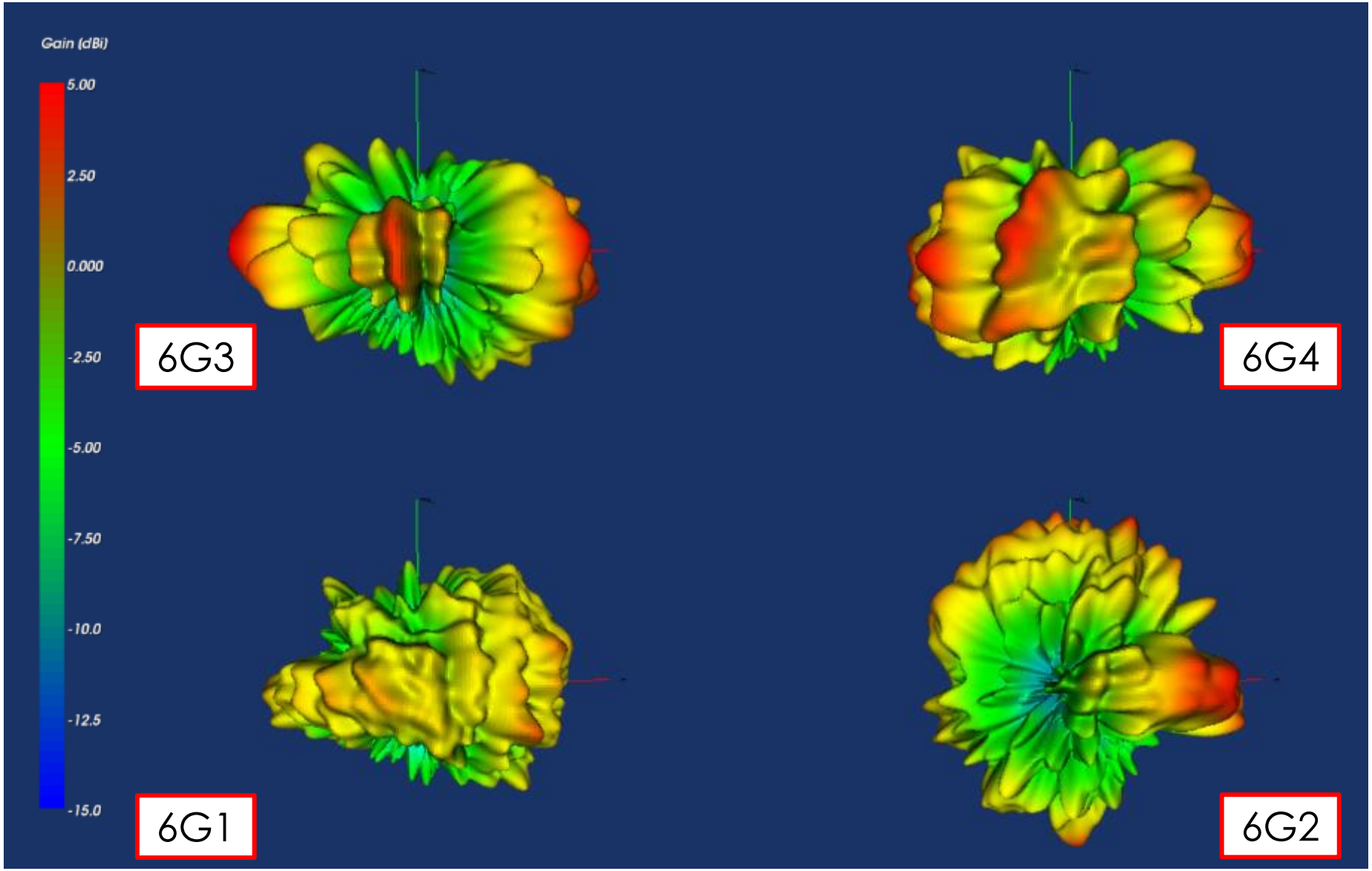


3D Gain Plot – 6 GHz Antennas – 7.125 GHz

Front-to-Back

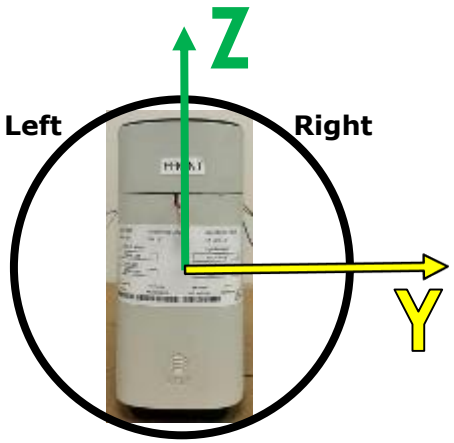


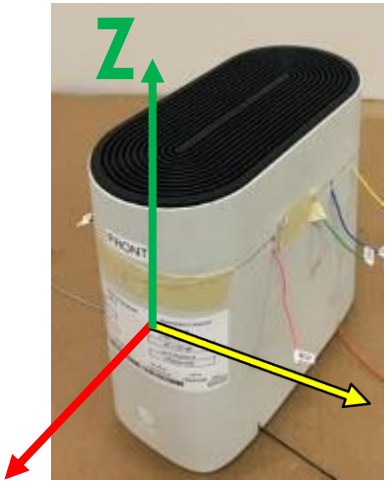


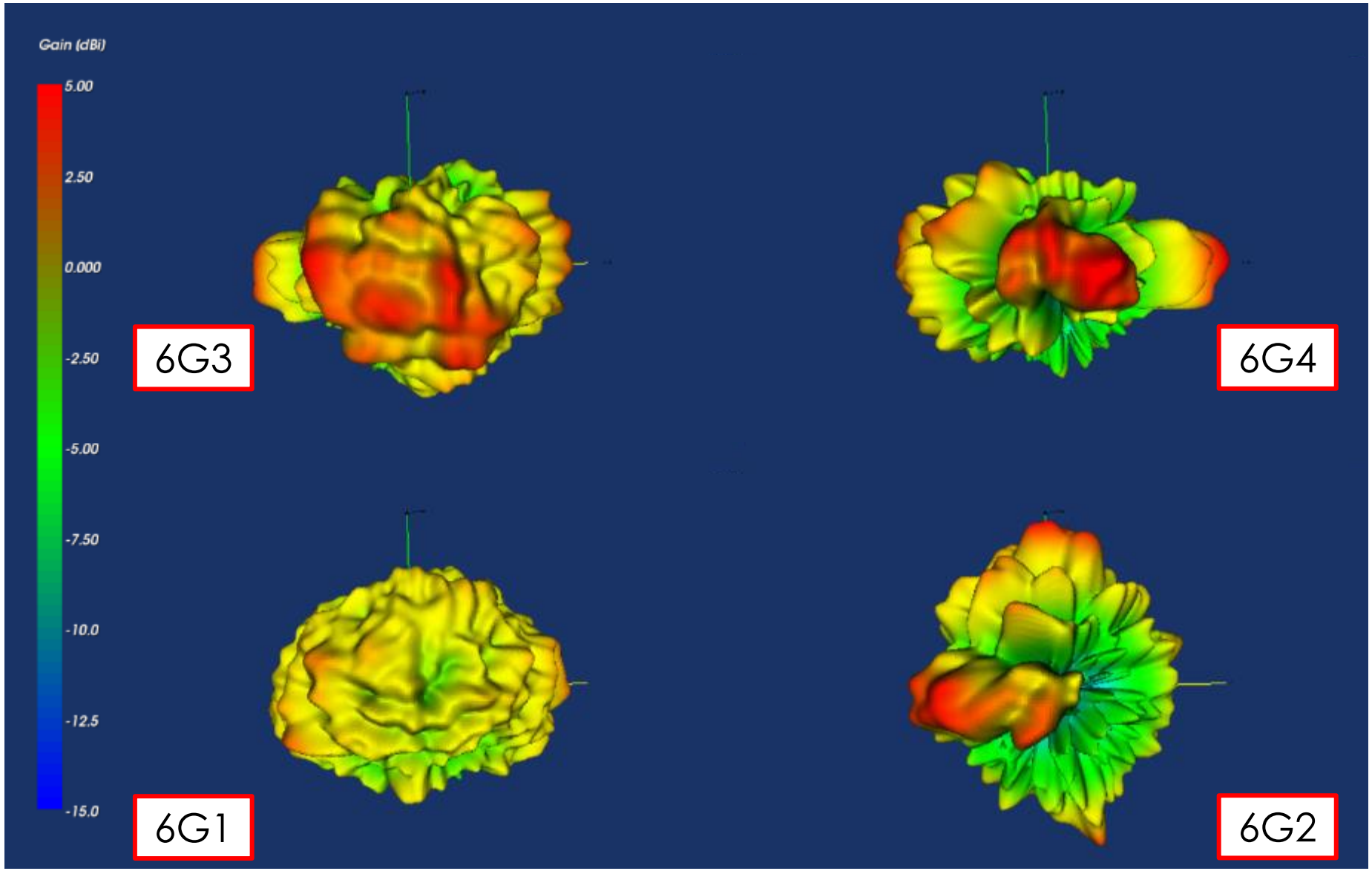


3D Gain Plot – 6 GHz Antennas – 7.125 GHz

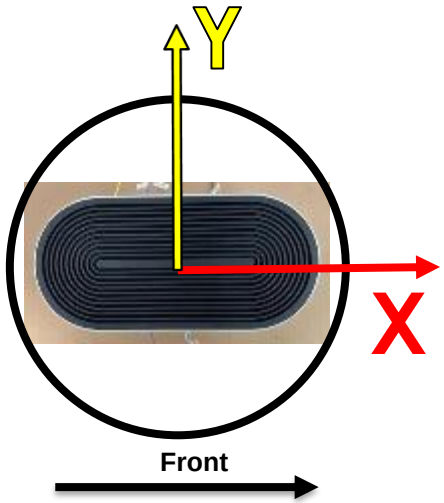
Side-to-Side

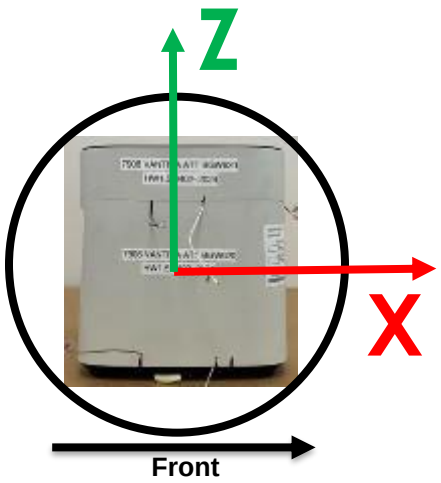


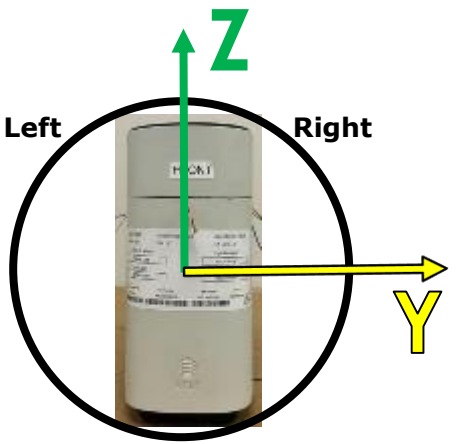


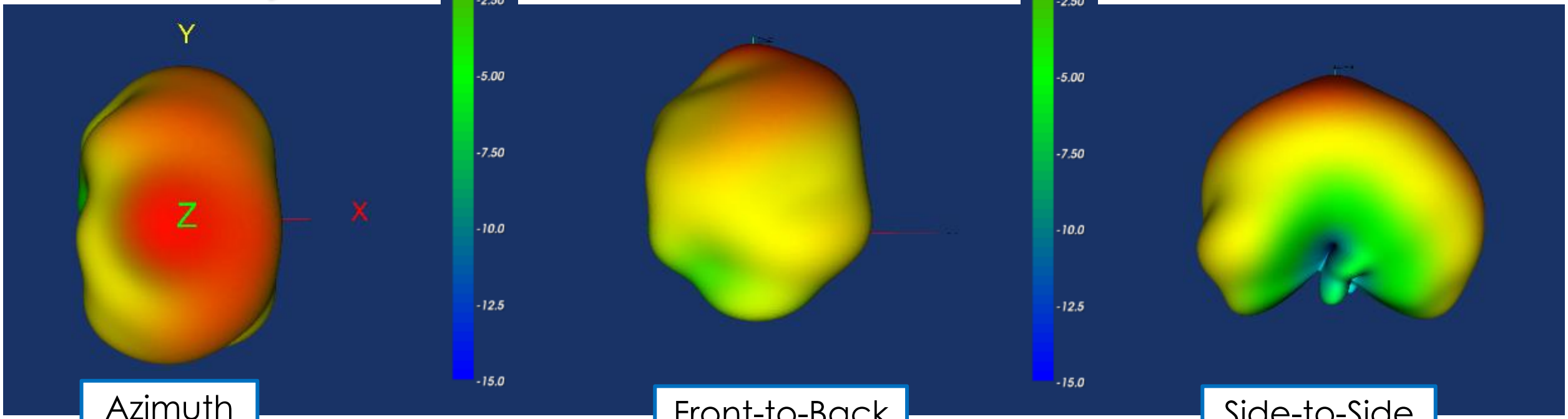


3D Gain Plot – GNSS Antenna – 1.575 GHz







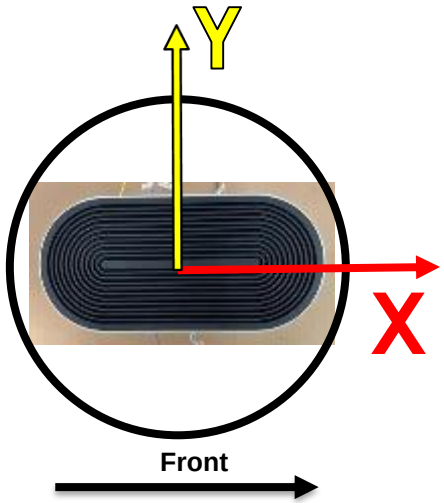


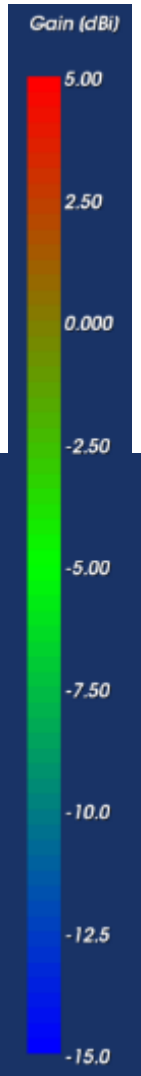
Azimuth

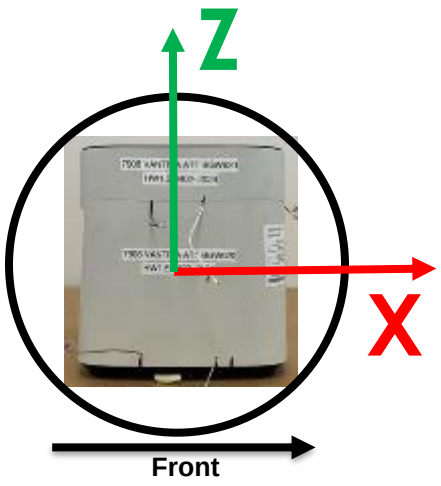
Front-to-Back

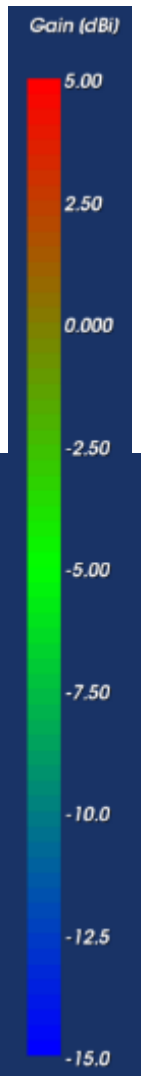
Side-to-Side

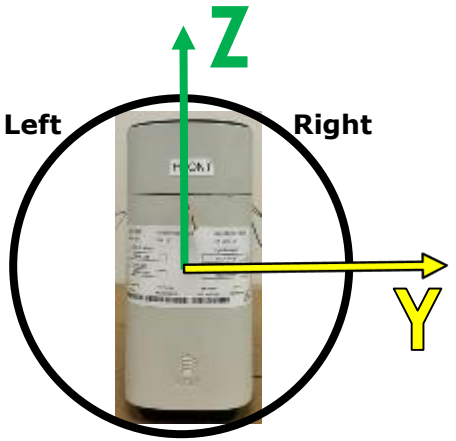
3D Gain Plot – DFS 5 GHz Antenna – 5.25 GHz









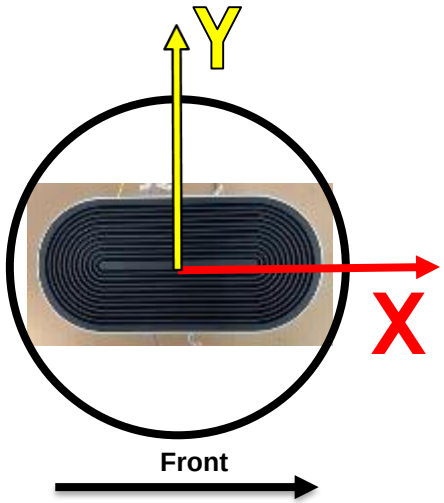


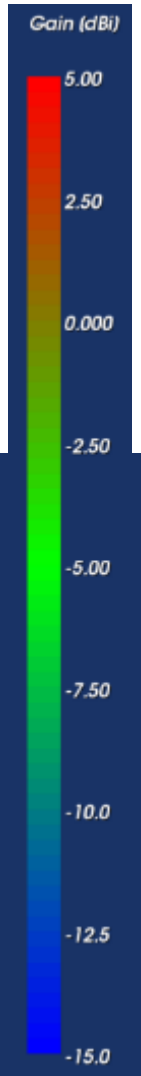
Azimuth

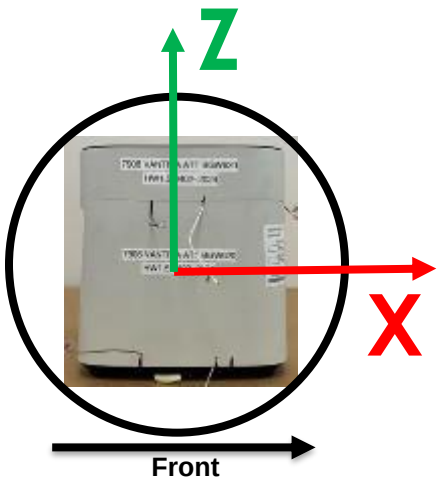
Front-to-Back

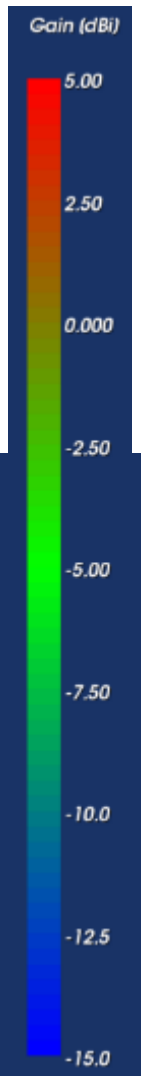
Side-to-Side

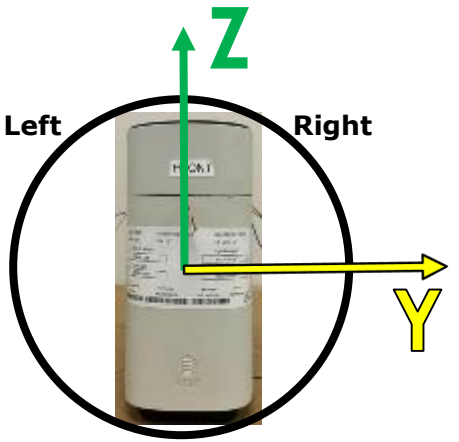
3D Gain Plot – DFS 5 GHz Antenna – 5.725 GHz

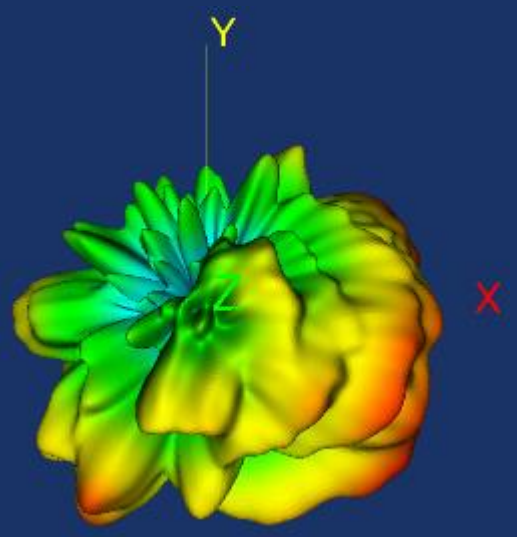


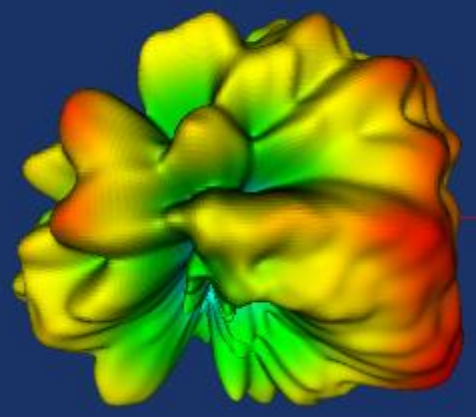


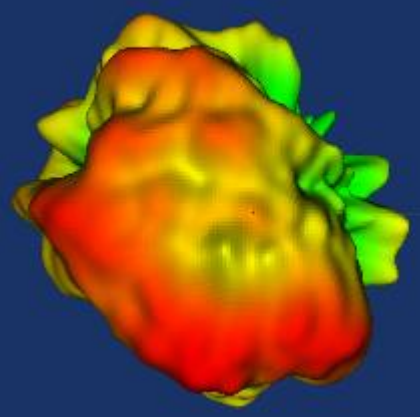










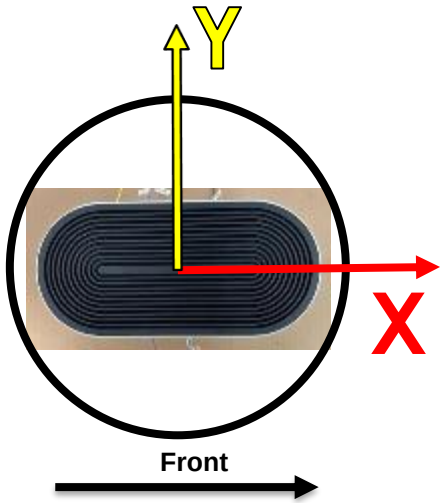


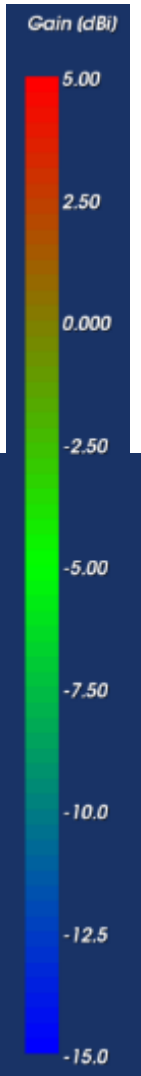
Azimuth

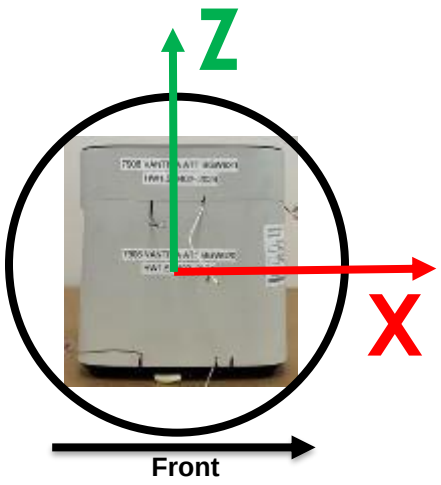
Front-to-Back

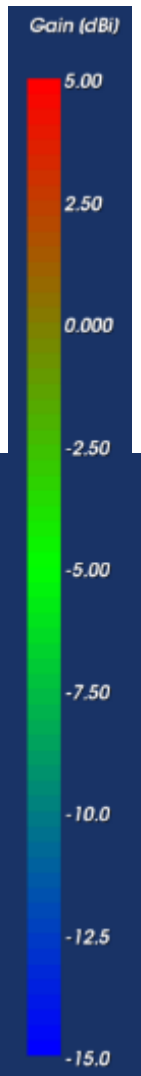
Side-to-Side

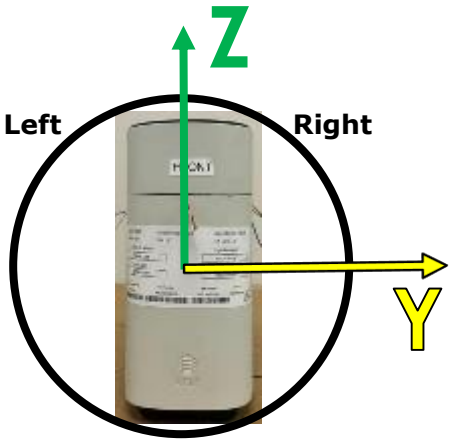
3D Gain Plot – DFS 6 GHz Antenna – 5.925 GHz

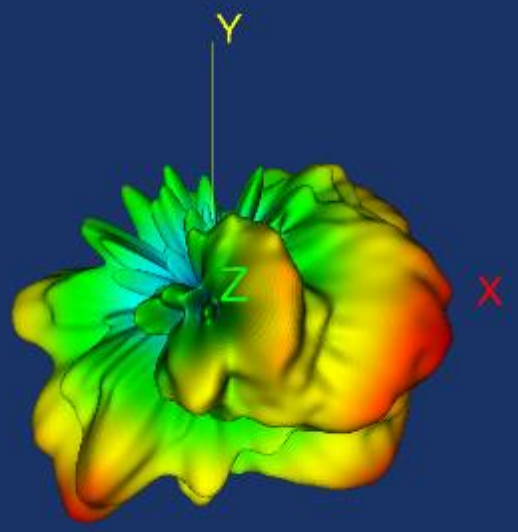




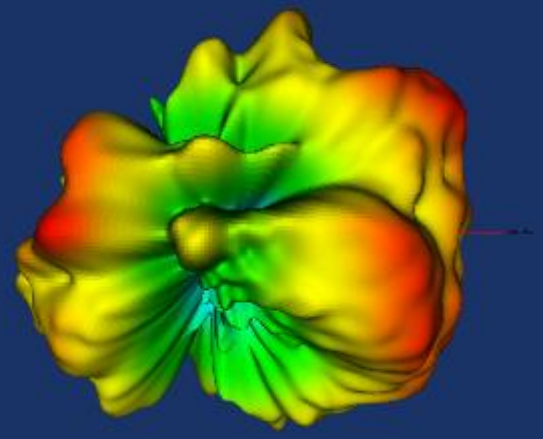




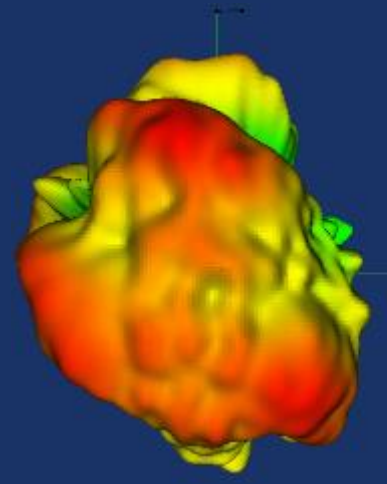




Azimuth

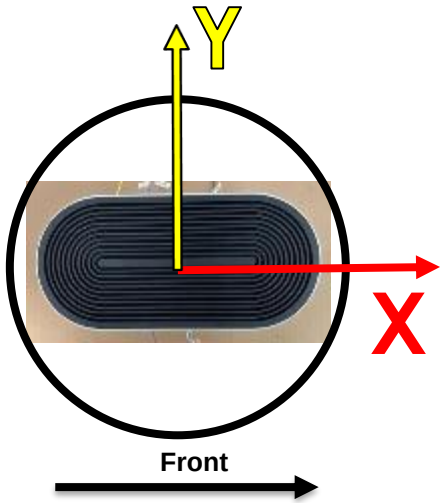


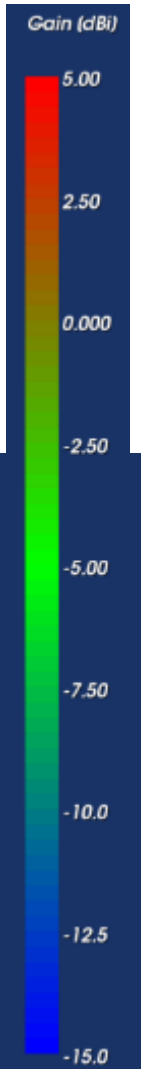
Front-to-Back

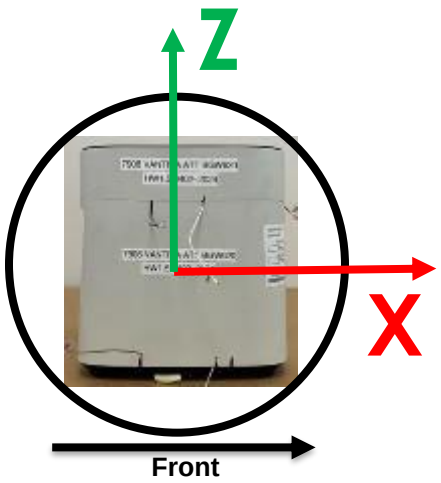


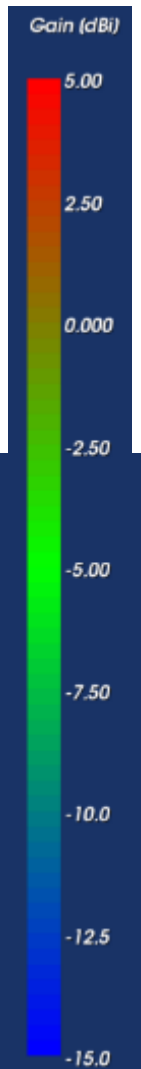
Side-to-Side

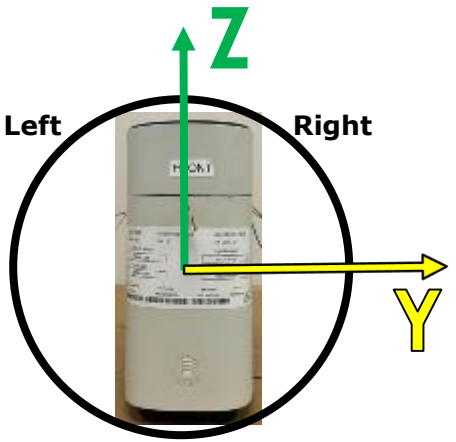
3D Gain Plot – DFS 6 GHz Antenna – 6.5 GHz









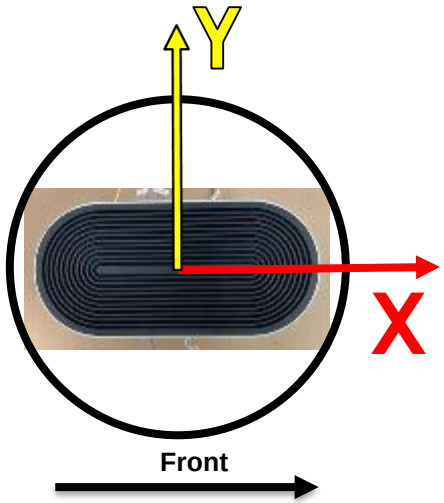


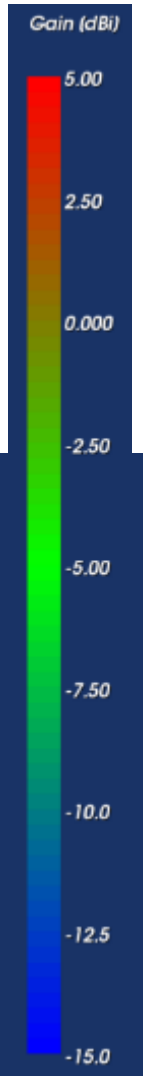
Azimuth

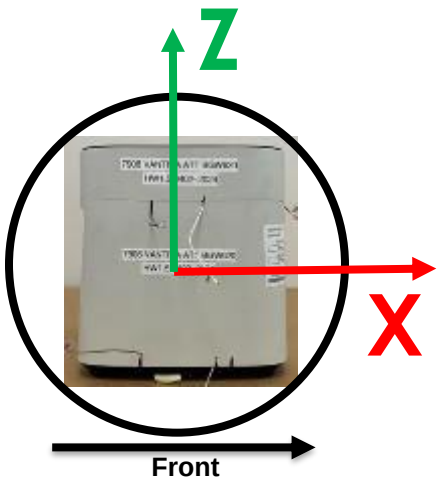
Front-to-Back

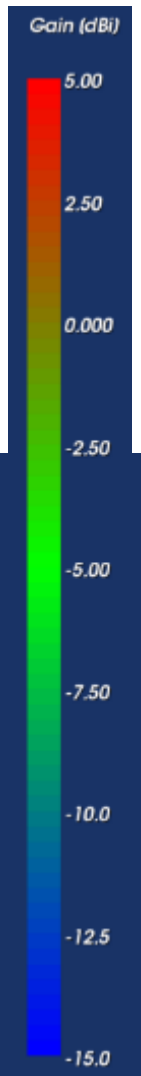
Side-to-Side

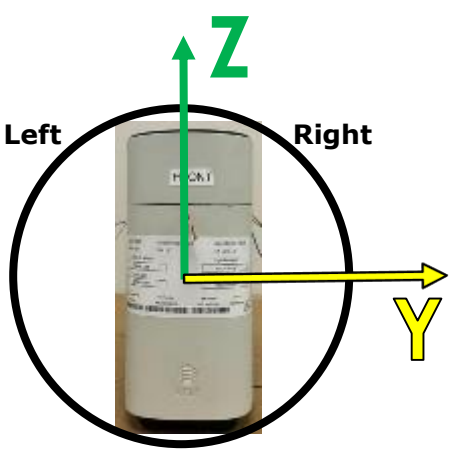
3D Gain Plot – DFS 6 GHz Antenna – 7.125 GHz

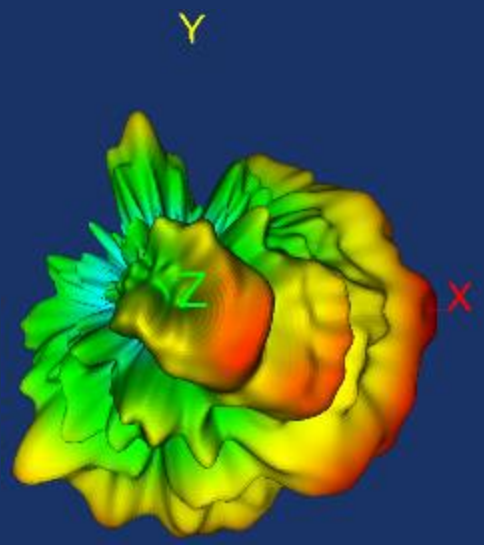


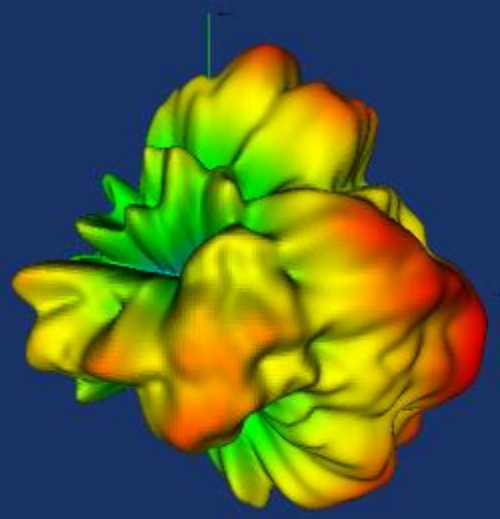


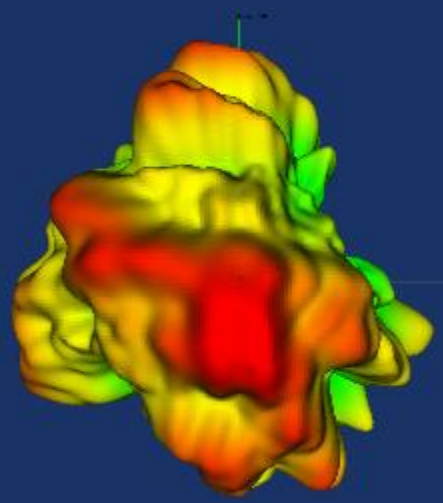










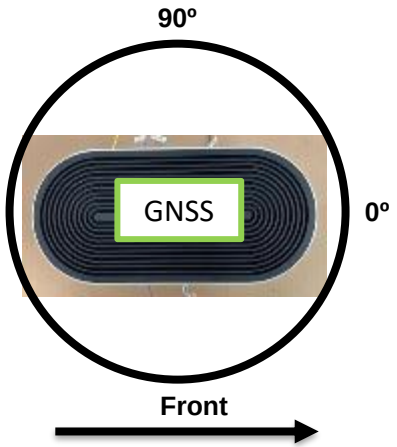


Azimuth

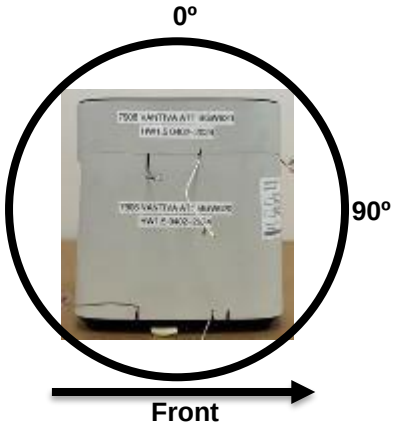
Front-to-Back

Side-to-Side

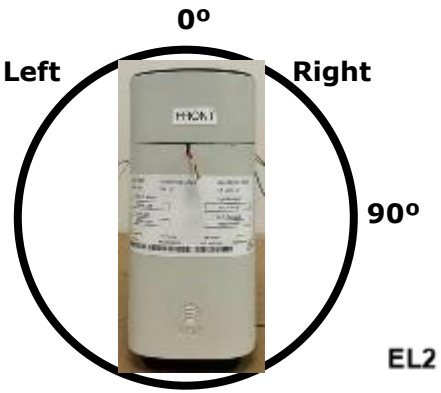
GNSS Antenna Power Sum Gain Patterns

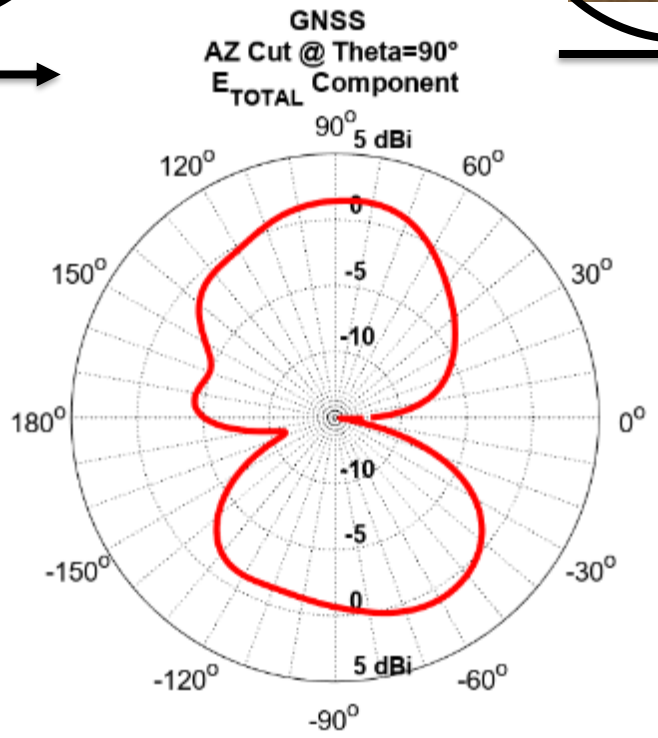


1575 MHz

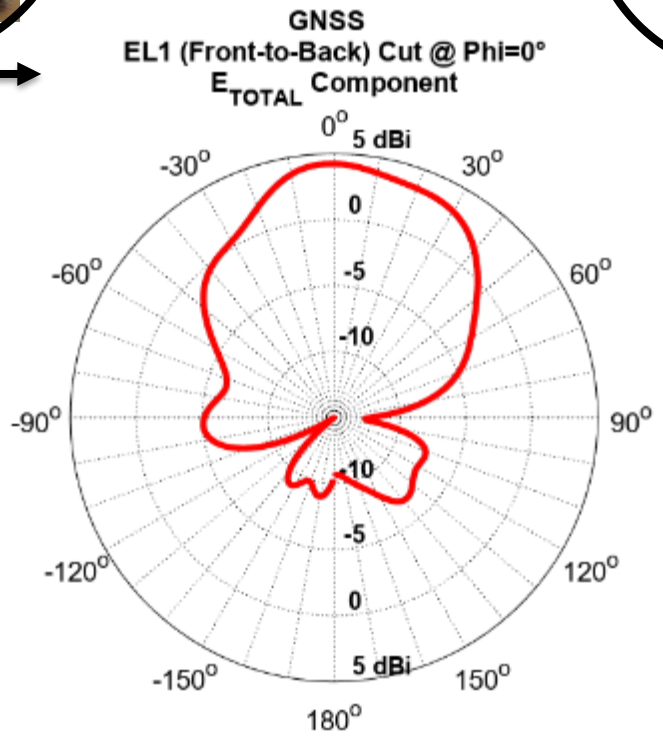


1575 MHz

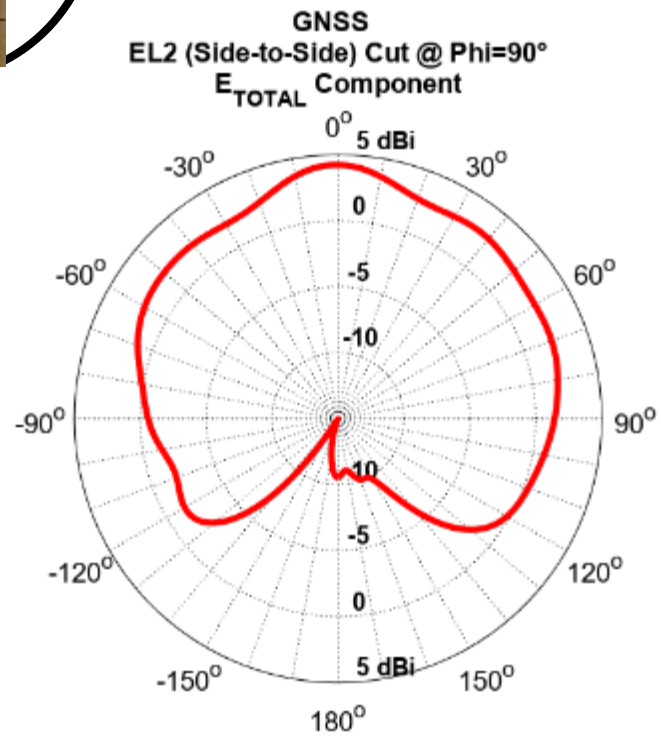




Azimuth Cut ($\theta = 90°$)

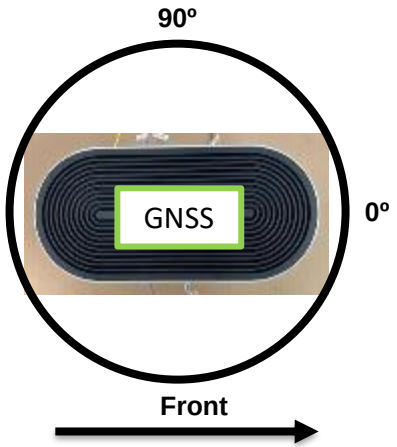


Elevation
(Front to Back) Cut

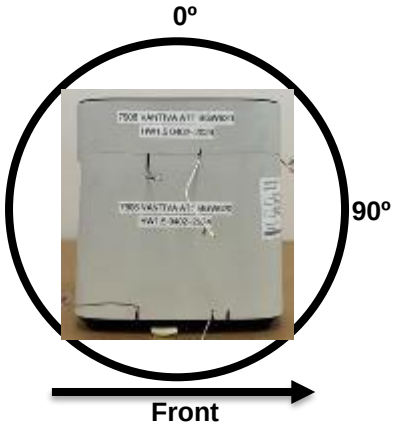


Elevation
(Side to Side) Cut

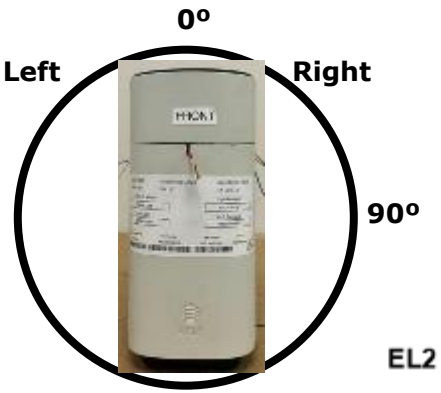
GNSS Antenna Power Sum Gain Patterns

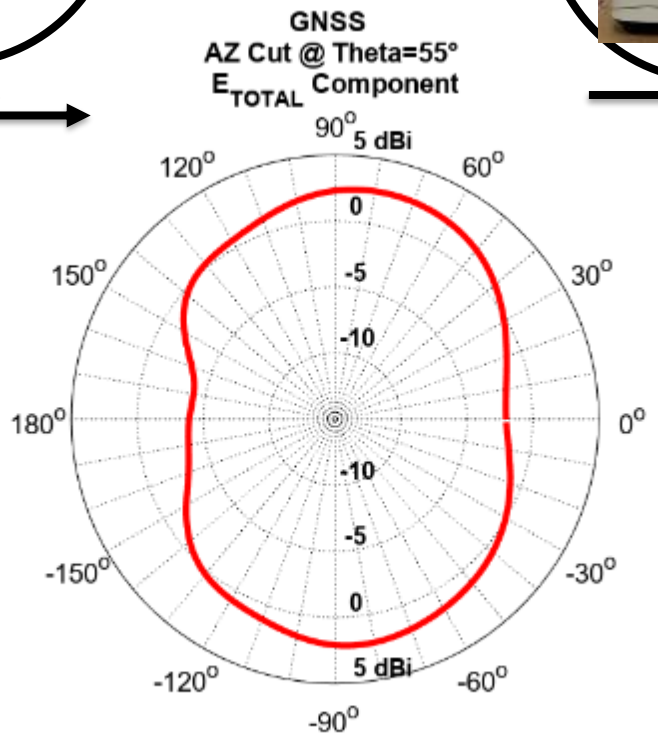


1575 MHz

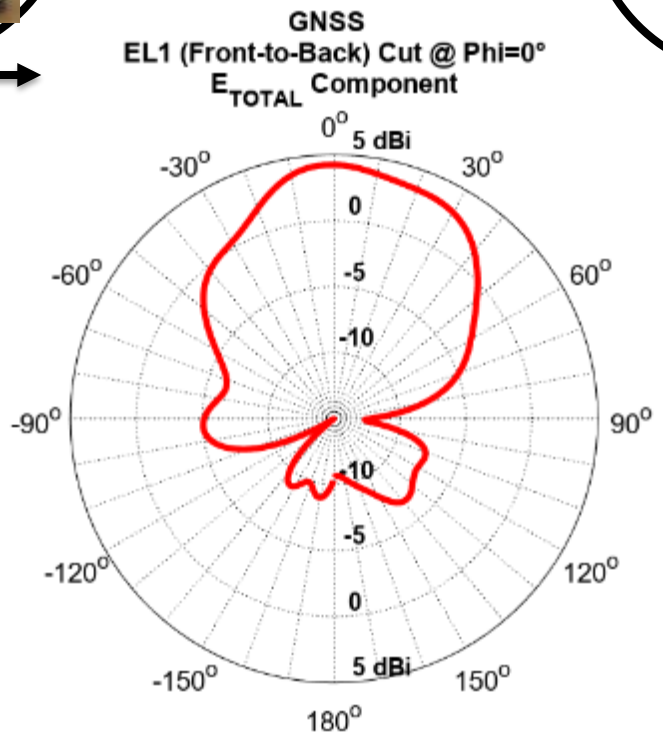


1575 MHz

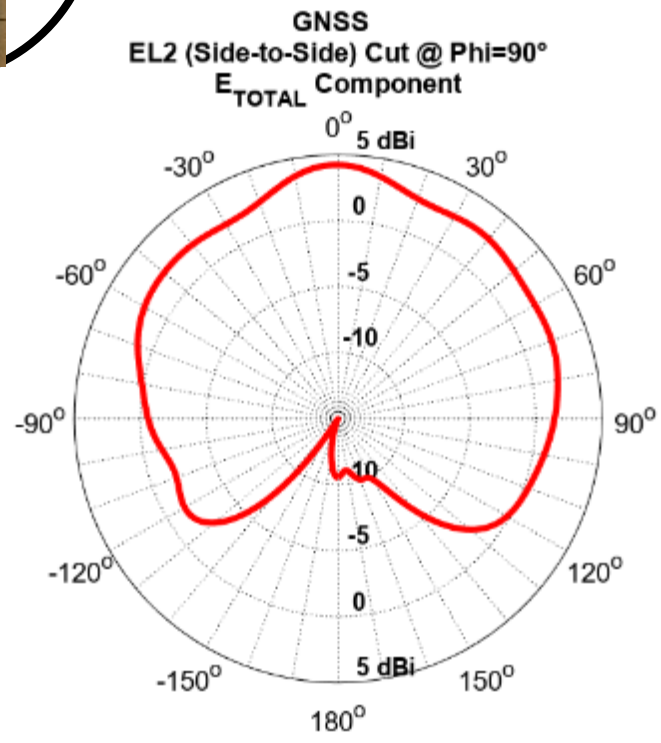




Azimuth Cut ($\theta = 35°$)
GPS inclination angle is 55°

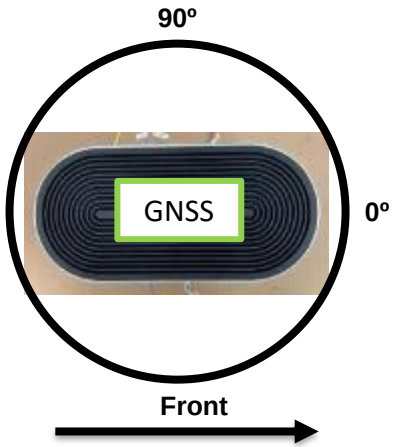


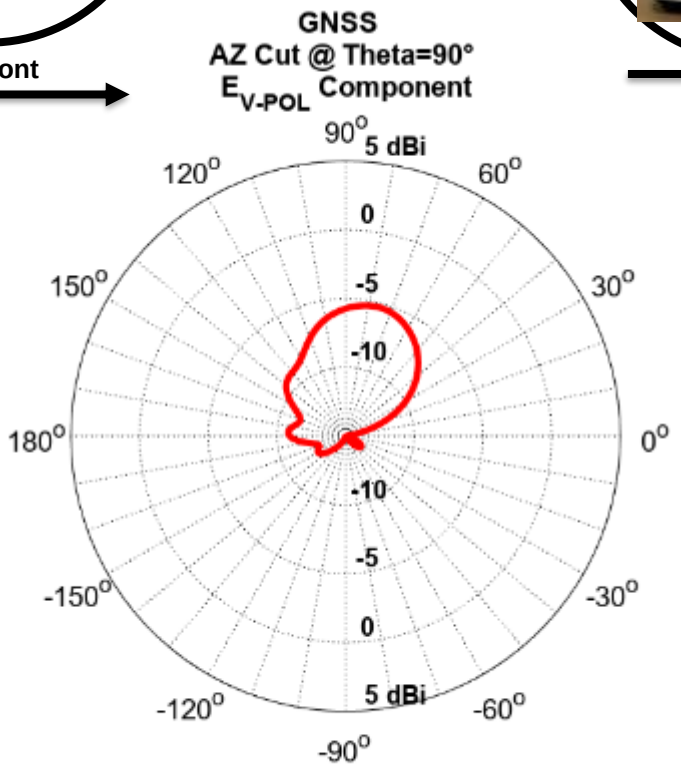
Elevation
(Front to Back) Cut



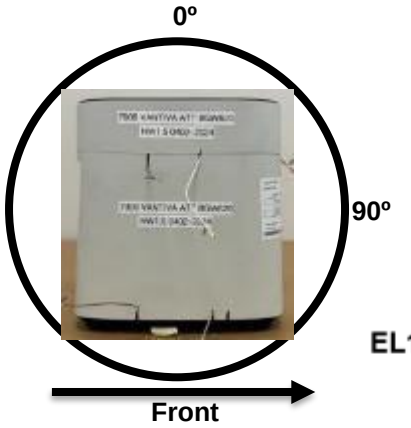
Elevation
(Side to Side) Cut

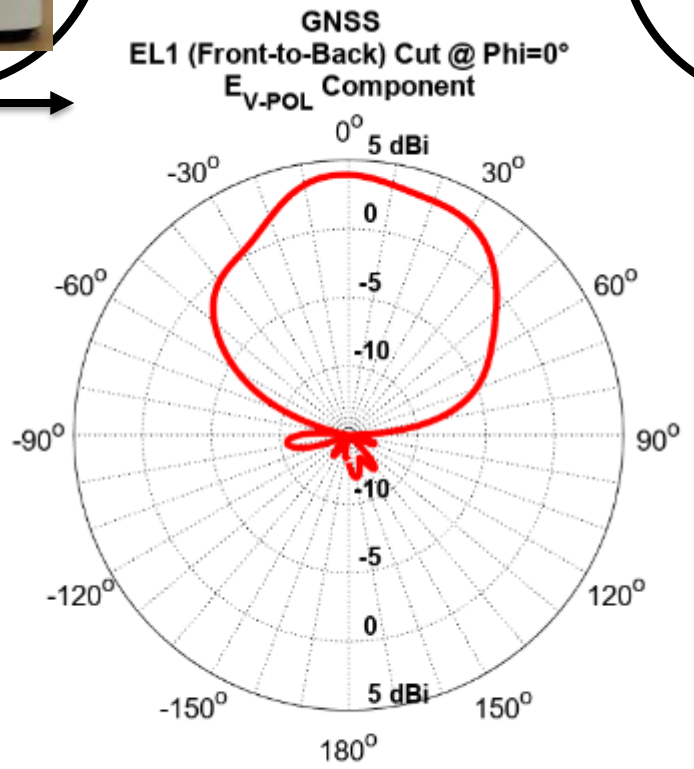
GNSS Antenna V-Pol Power Gain Patterns



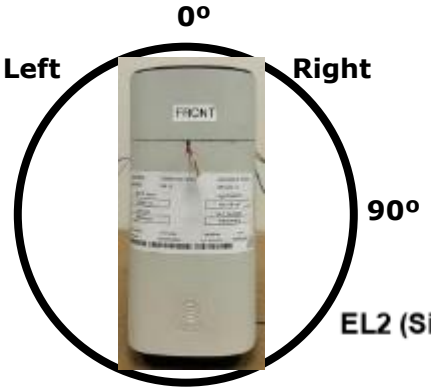


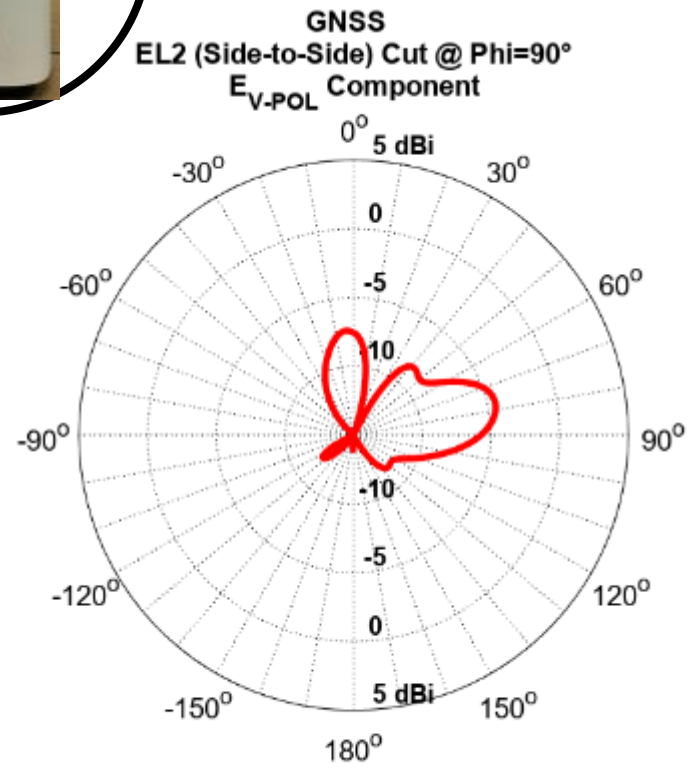
Azimuth Cut ($\theta = 90°$)





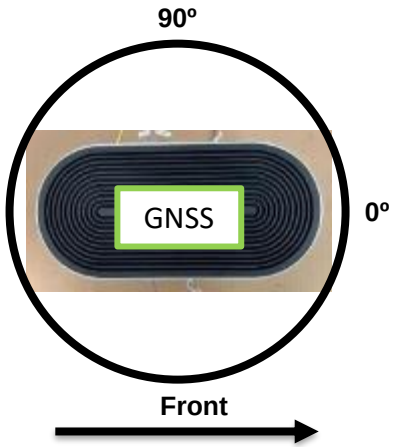
Elevation
(Front to Back) Cut

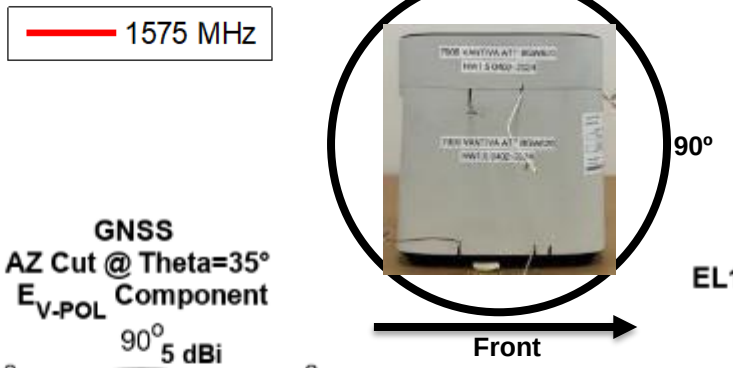


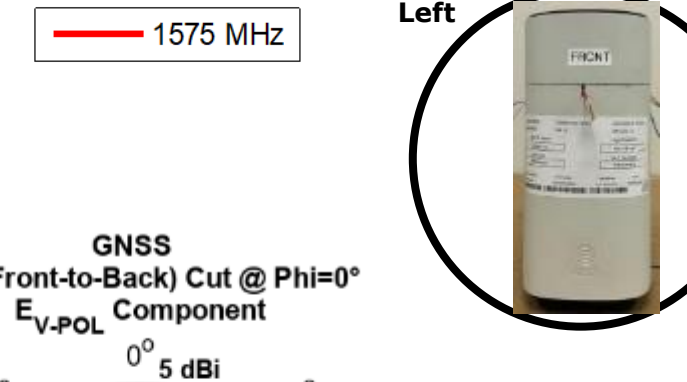


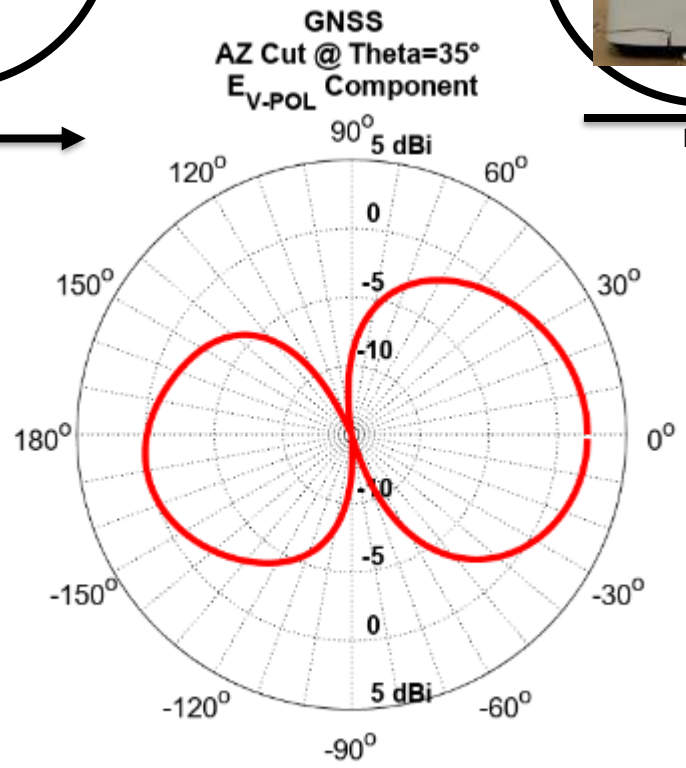
Elevation
(Side to Side) Cut

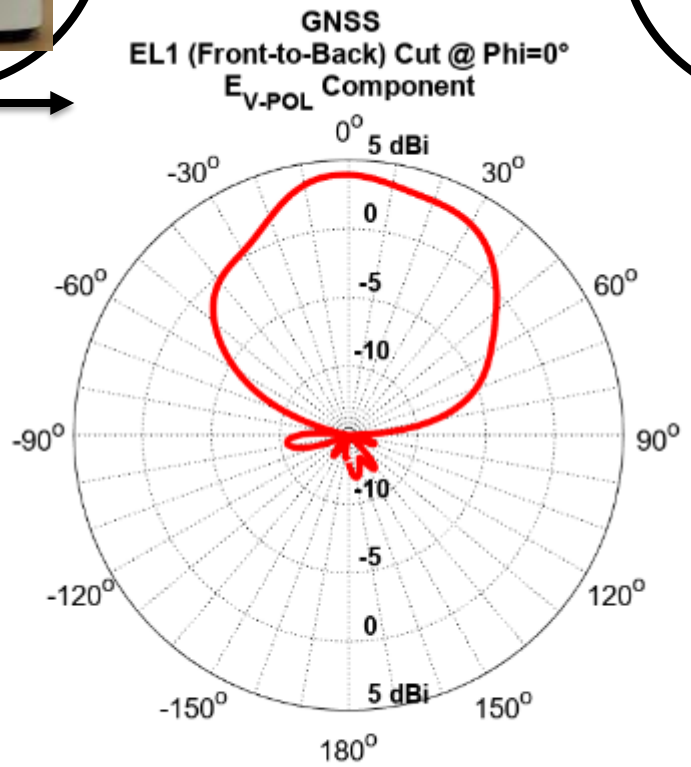
GNSS Antenna V-Pol Power Gain Patterns

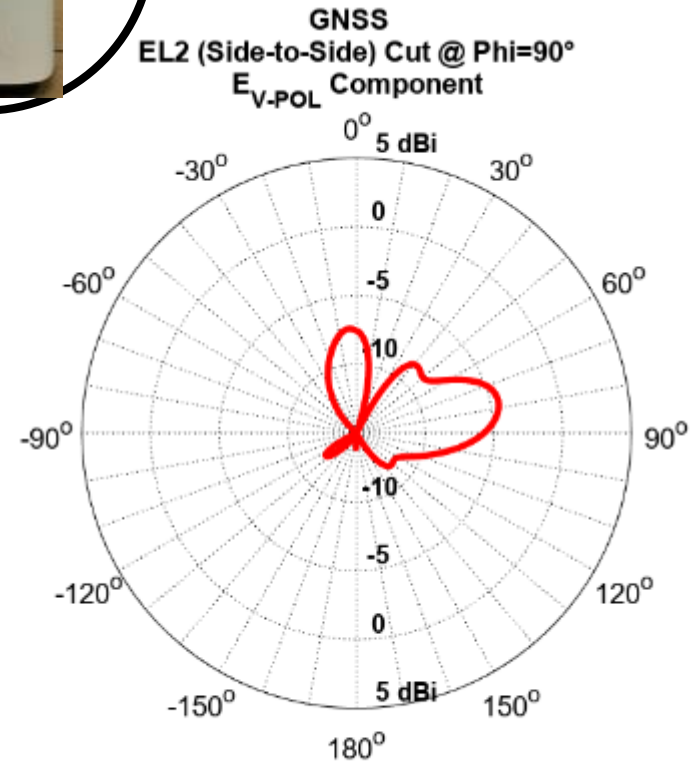










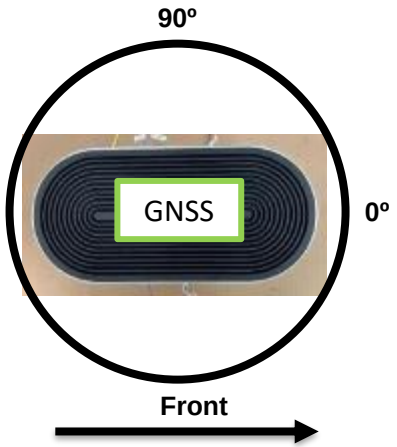


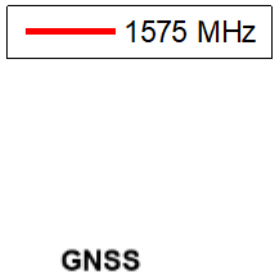
Azimuth Cut ($\theta = 35°$)
GPS inclination angle is 55°

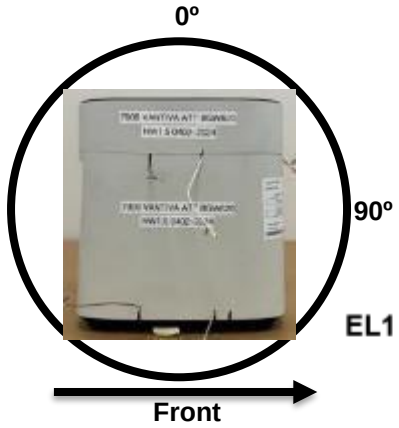
Elevation
(Front to Back) Cut

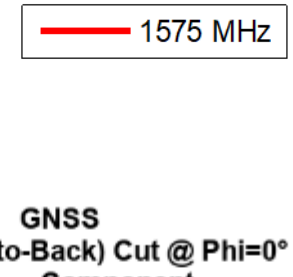
Elevation
(Side to Side) Cut

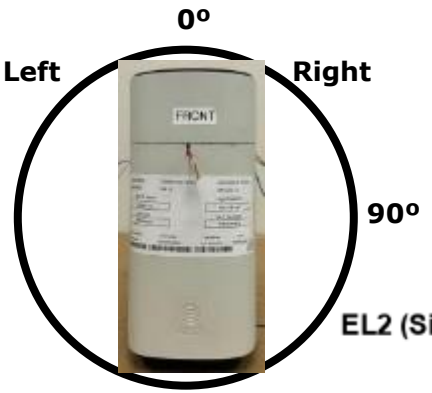
GNSS Antenna H-Pol Power Gain Patterns

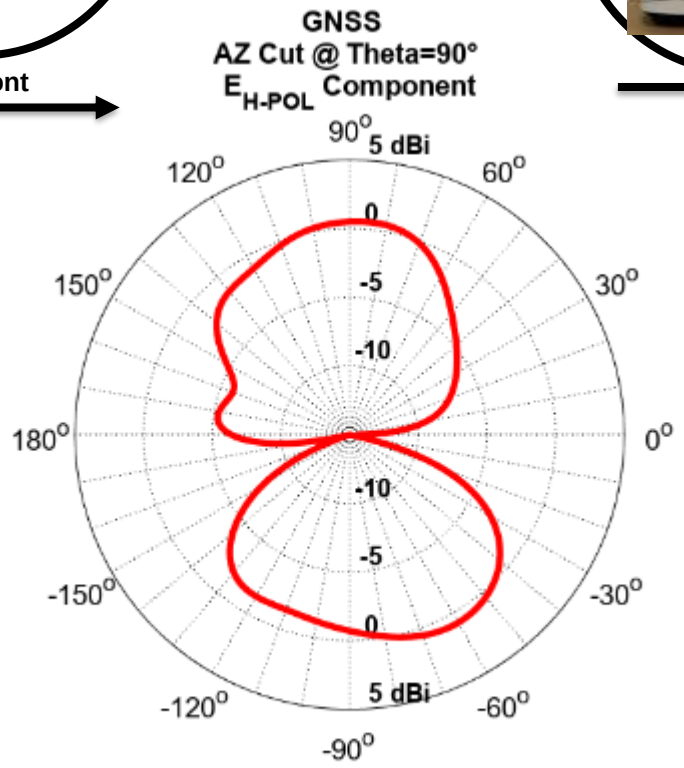




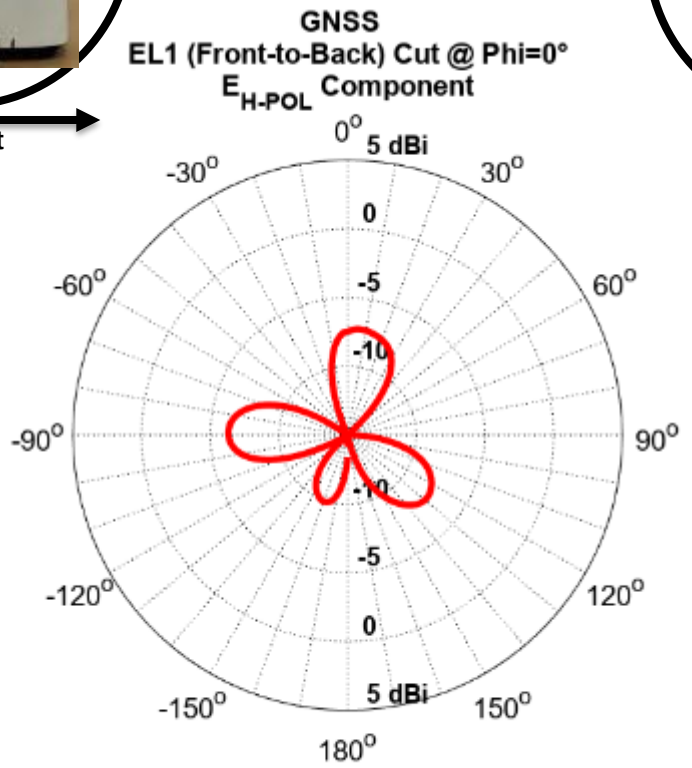




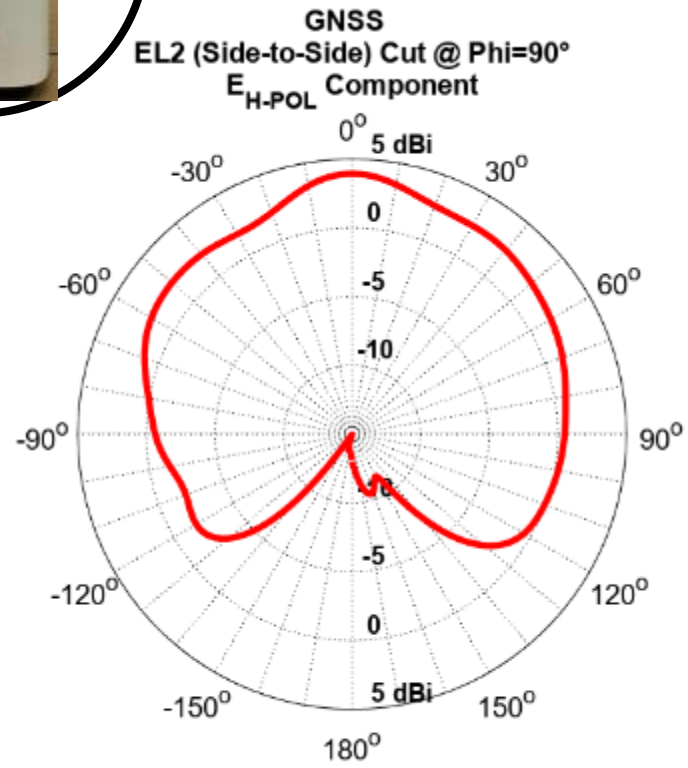




Azimuth Cut ($\theta = 90°$)

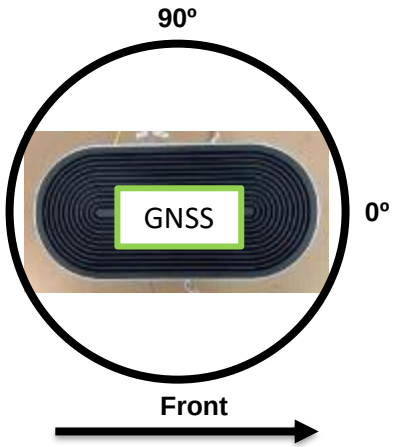


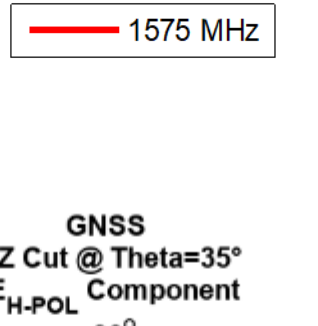
Elevation
(Front to Back) Cut

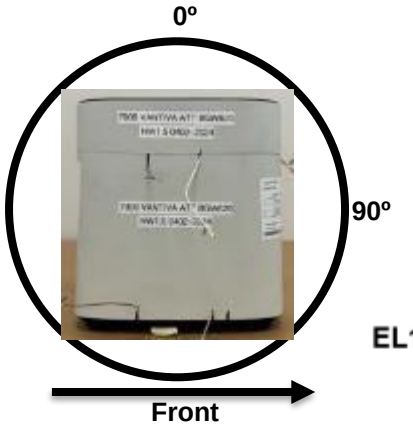


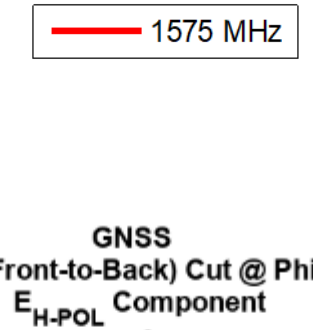
Elevation
(Side to Side) Cut

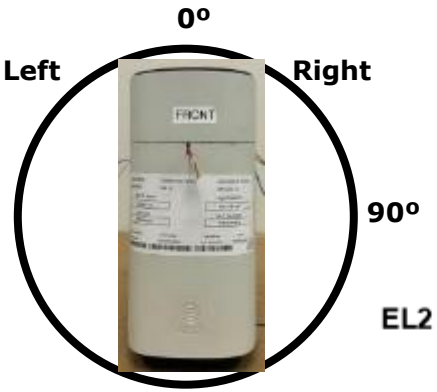
GNSS Antenna H-Pol Power Gain Patterns

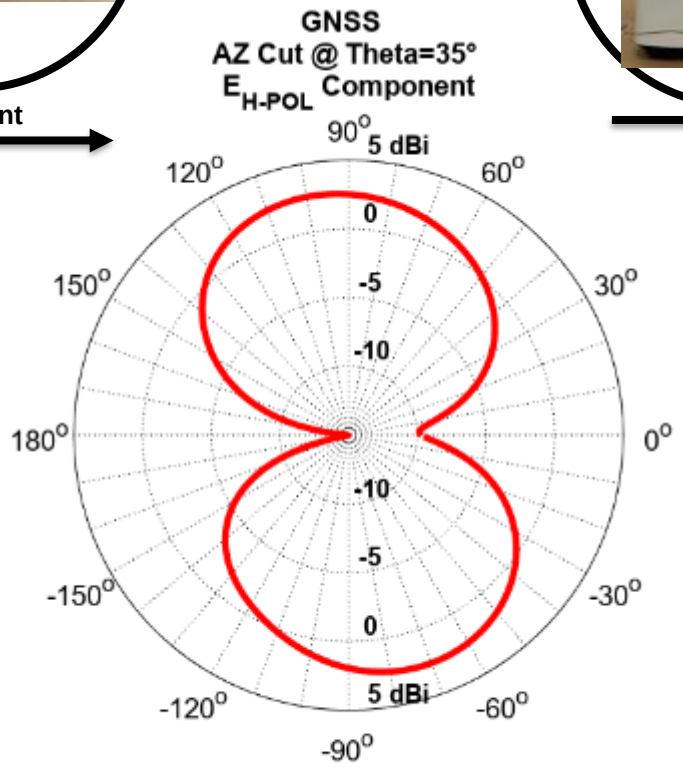




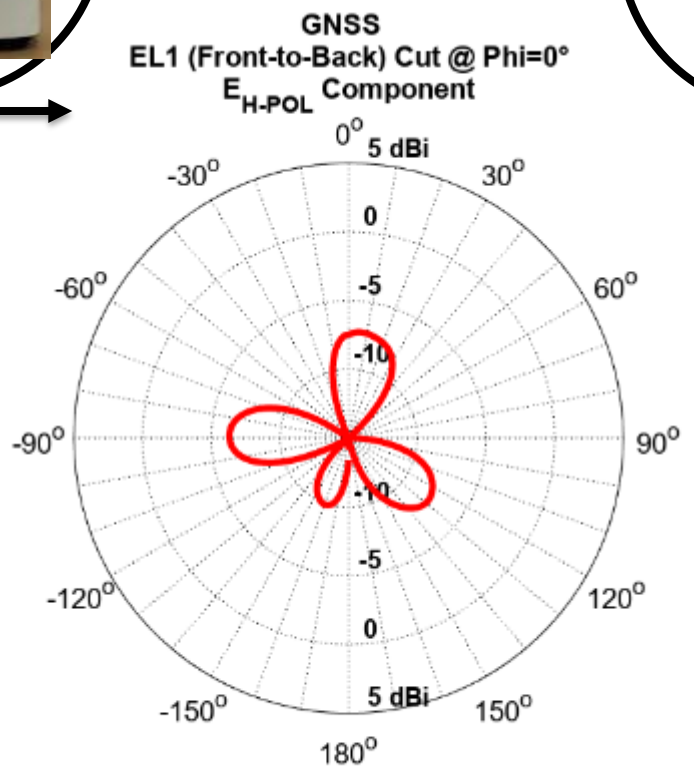




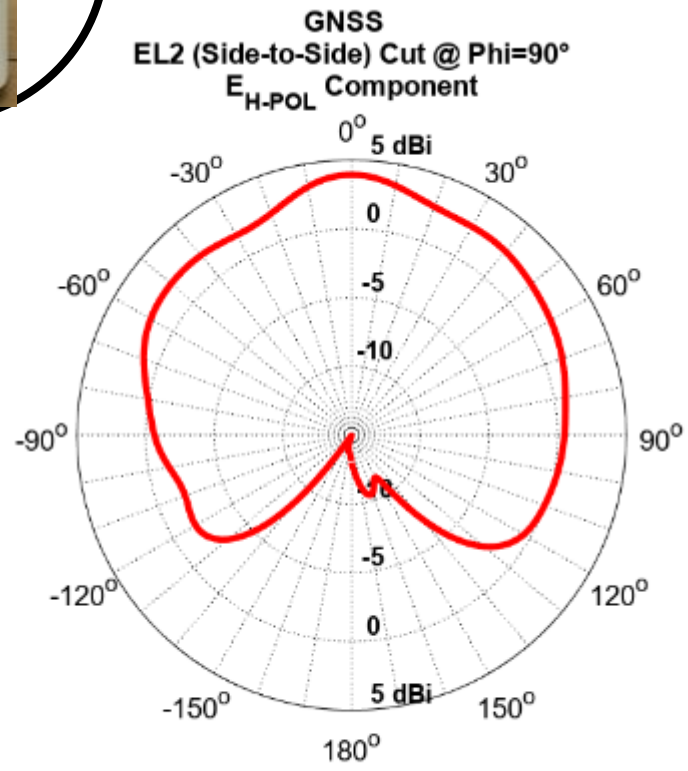




Azimuth Cut ($\theta = 35°$)
GPS inclination angle is 55°



Elevation
(Front to Back) Cut

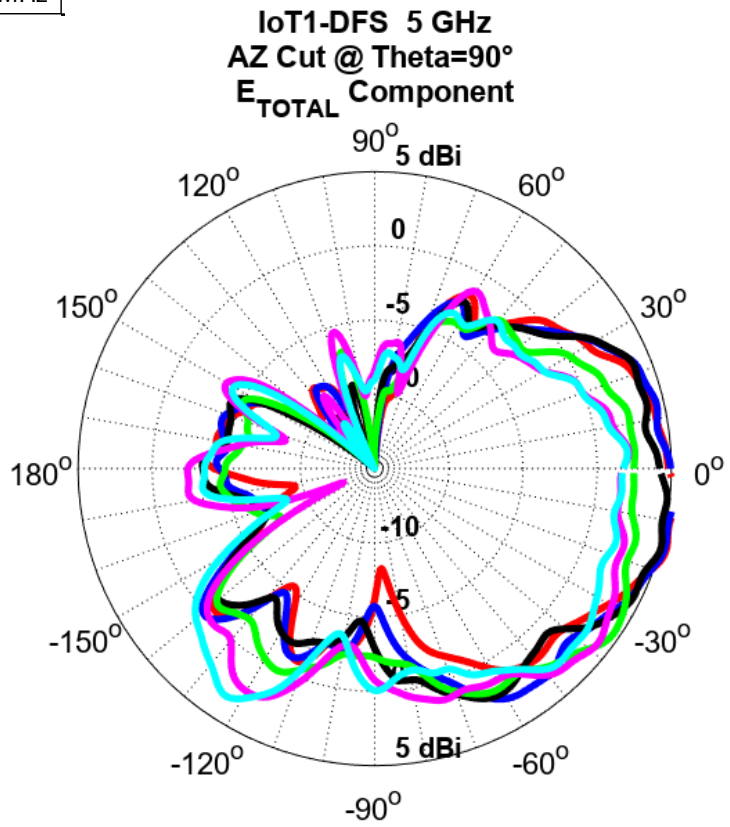


Elevation
(Side to Side) Cut

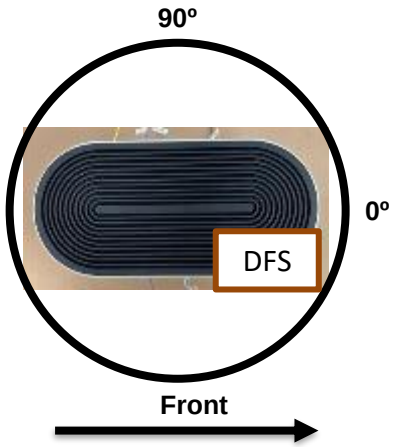
Azimuth Cut - Power Sum

DFS Antenna

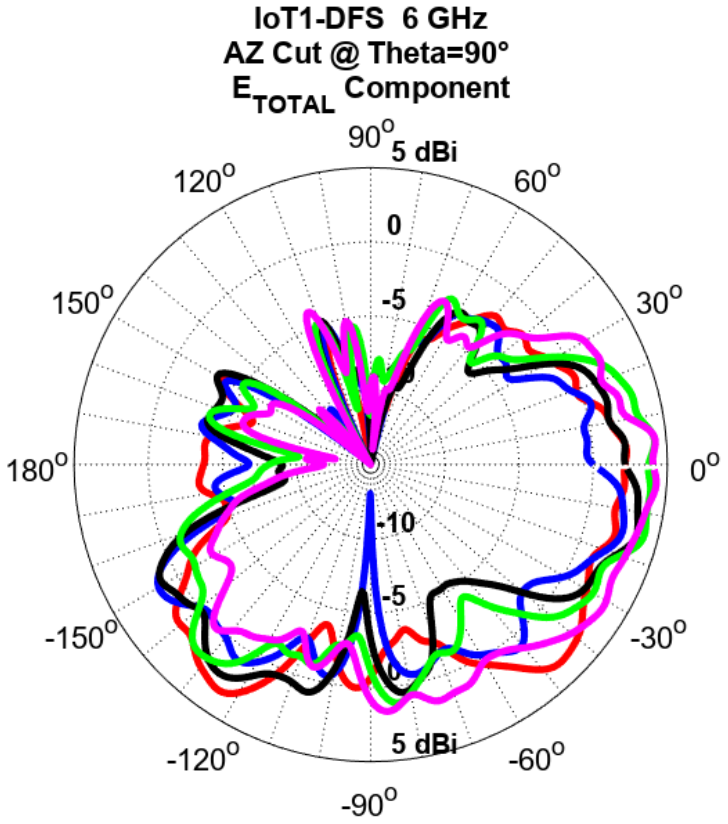
5150 MHz
5250 MHz
5350 MHz
5500 MHz
5725 MHz
5825 MHz



DFS-5 GHz



5925 MHz
6300 MHz
6500 MHz
6800 MHz
7125 MHz

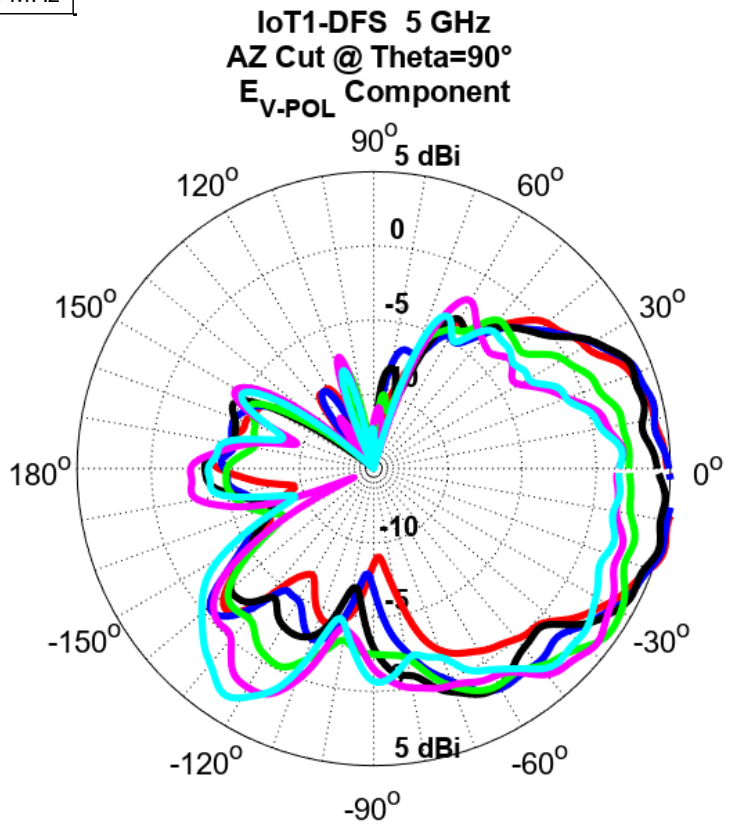


DFS-6 GHz

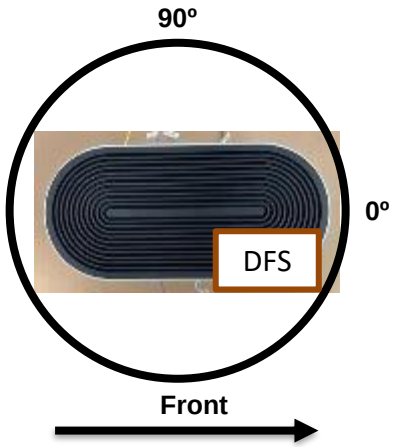
Azimuth Cut – V-Pol Power

DFS Antenna

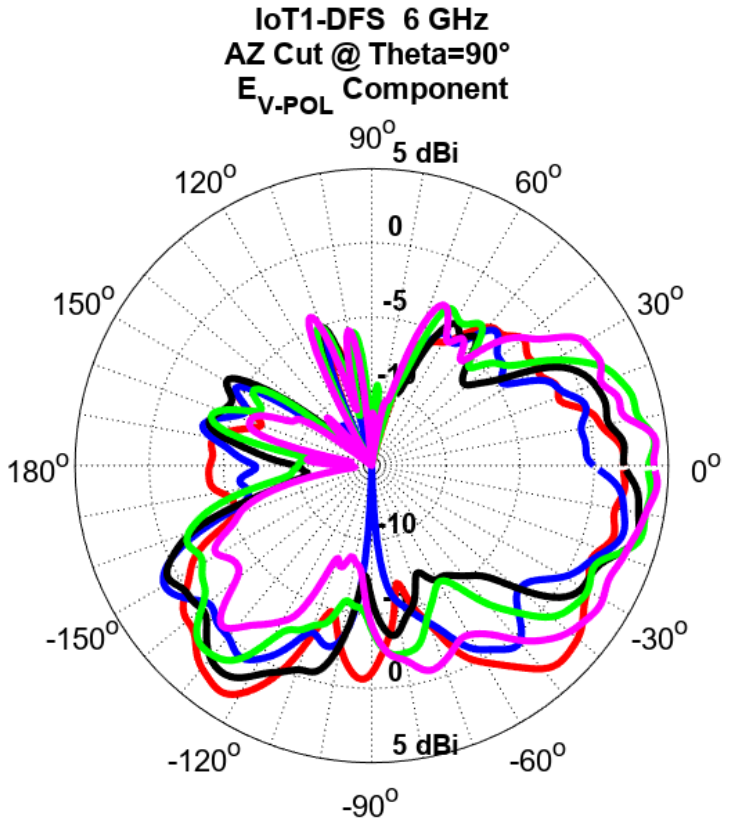
5150 MHz
5250 MHz
5350 MHz
5500 MHz
5725 MHz
5825 MHz



DFS-5 GHz



5925 MHz
6300 MHz
6500 MHz
6800 MHz
7125 MHz

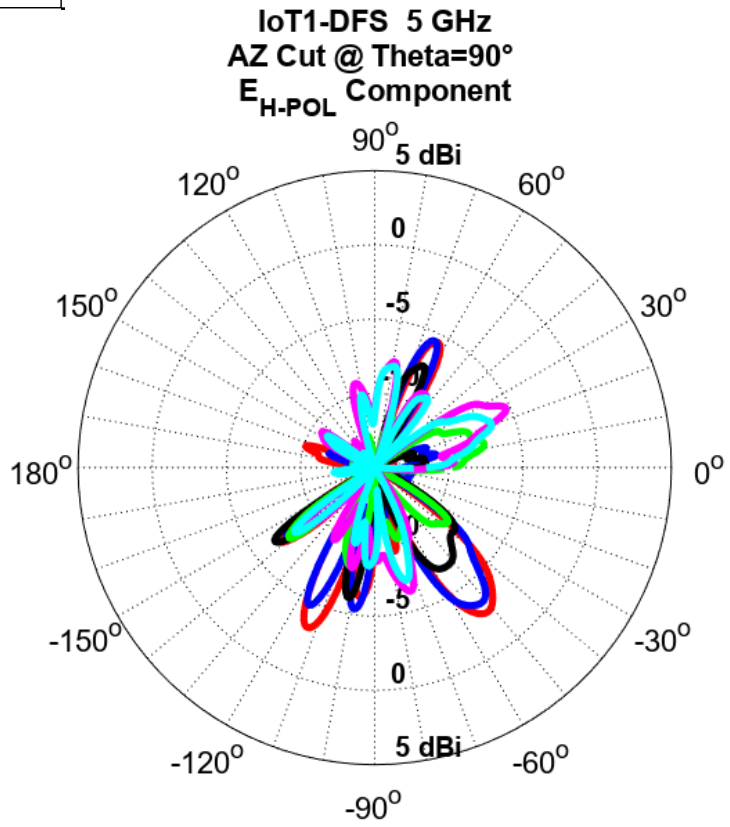


DFS-6 GHz

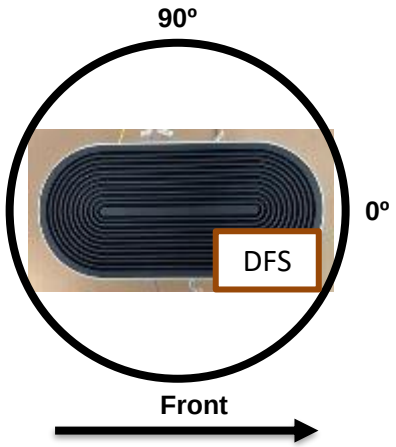
Azimuth Cut – H-Pol Power

DFS Antenna

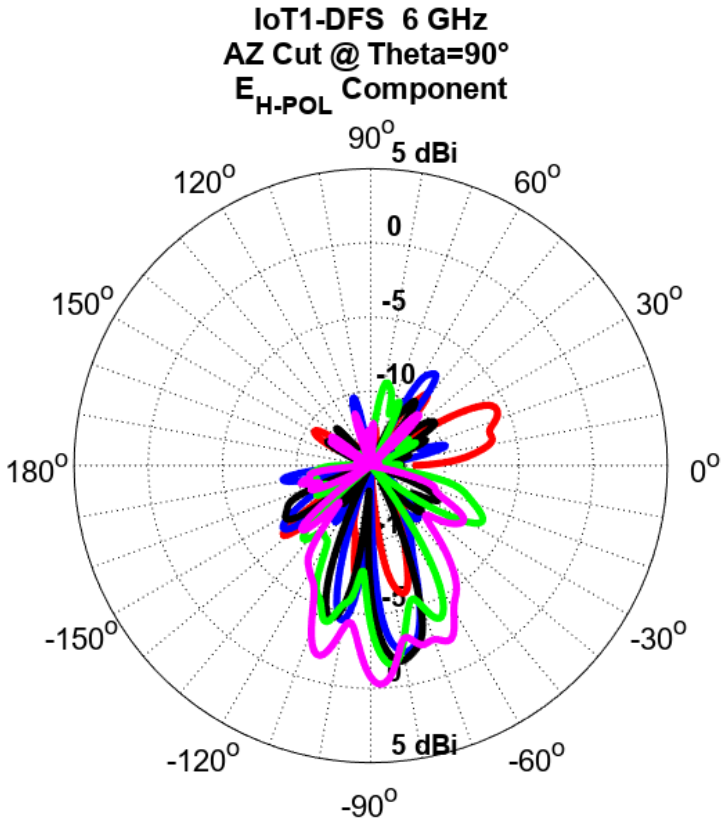
5150 MHz
5250 MHz
5350 MHz
5500 MHz
5725 MHz
5825 MHz



DFS-5 GHz



5925 MHz
6300 MHz
6500 MHz
6800 MHz
7125 MHz



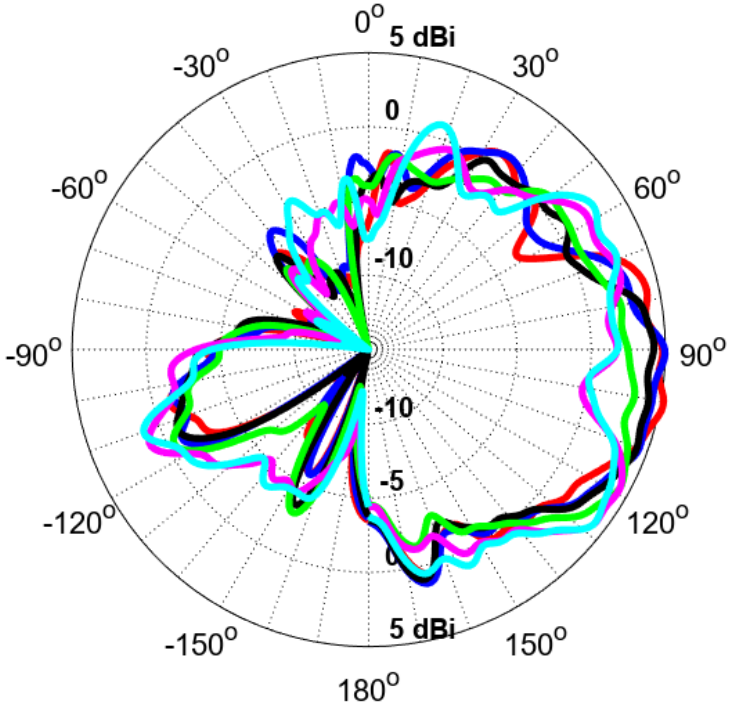
DFS-6 GHz

Elevation (Front to Back) Cut - Power Sum

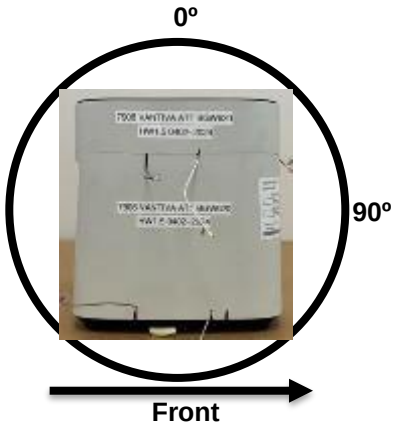
DFS Antenna

5150 MHz
5250 MHz
5350 MHz
5500 MHz
5725 MHz
5825 MHz

IoT1-DFS 5 GHz
EL1 (Front-to-Back) Cut @ Phi=0°
E_{TOTAL} Component

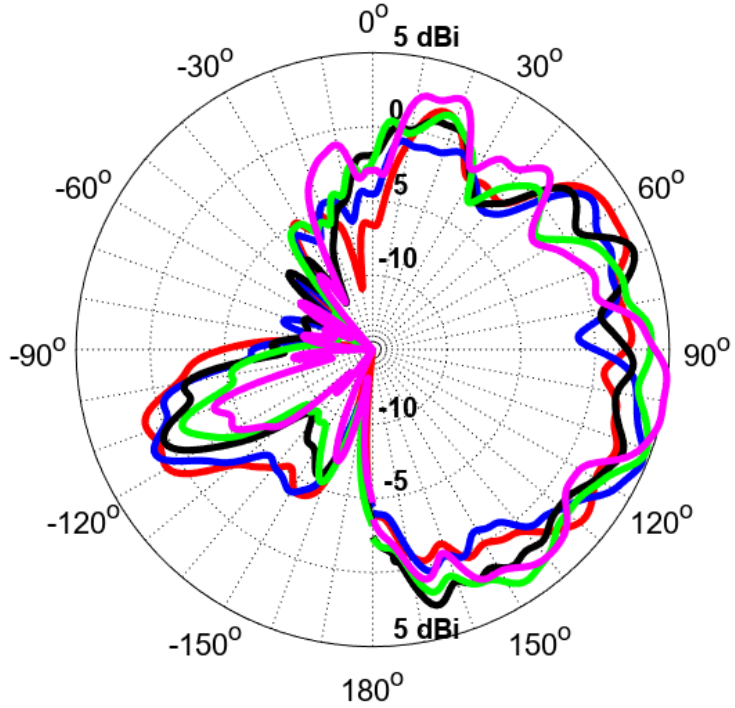


DFS-5 GHz



5925 MHz
6300 MHz
6500 MHz
6800 MHz
7125 MHz

IoT1-DFS 6 GHz
EL1 (Front-to-Back) Cut @ Phi=0°
E_{TOTAL} Component



DFS-6 GHz