

GALTRONICS

WHEN CONNECTIONS COUNT



Vantiva ATT WiFi 7 PON Gateway Triband Antenna Performance Report

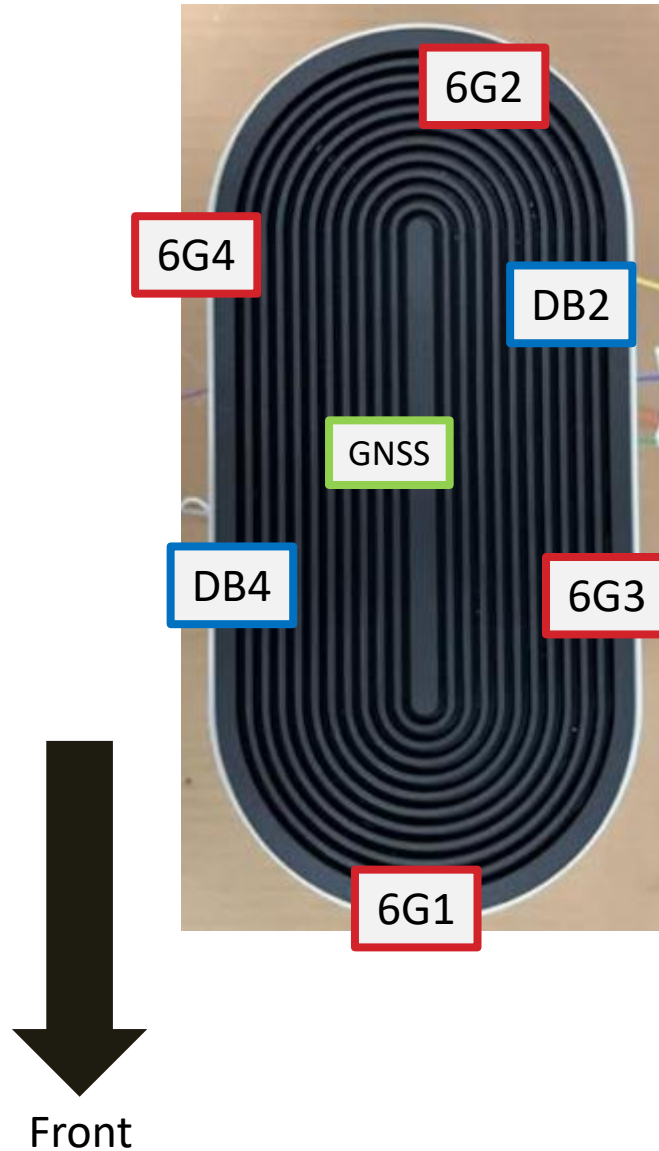
Galtronics Project: 7908

Prepared by Junho Cha
April 08, 2024

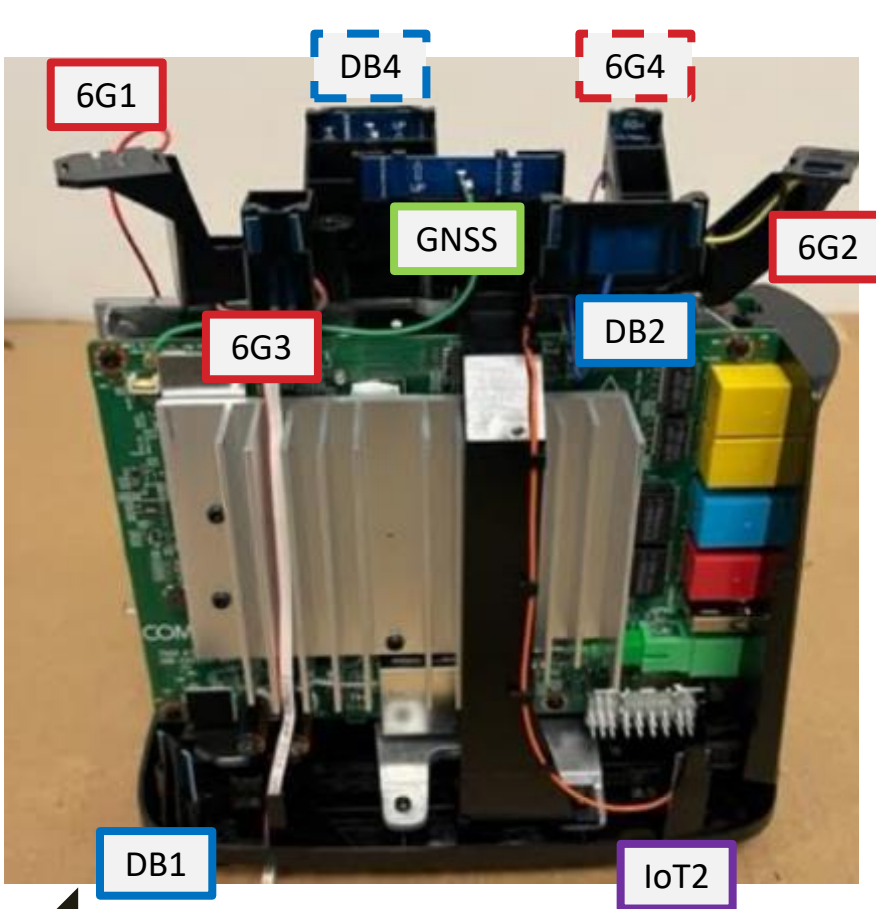
Introduction

- » 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.

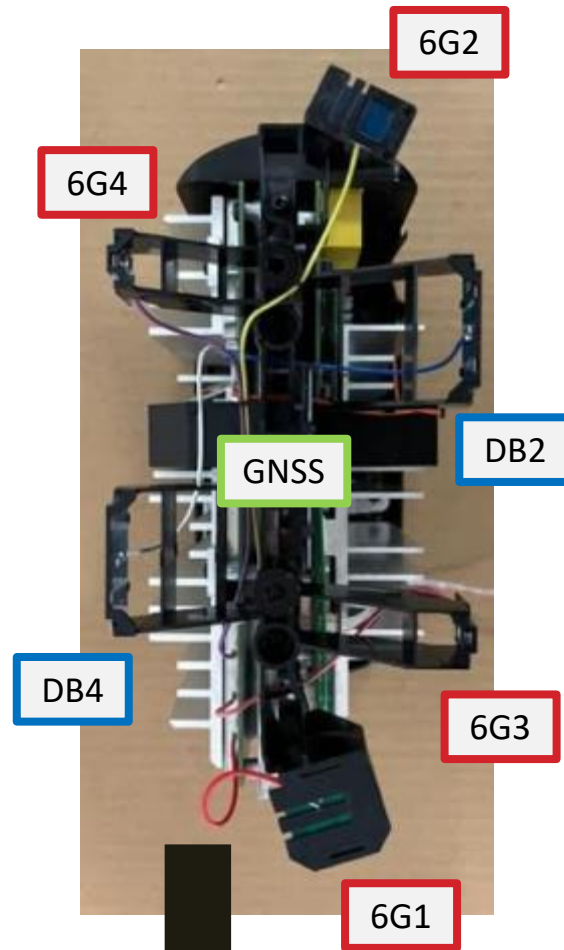
Antenna Location



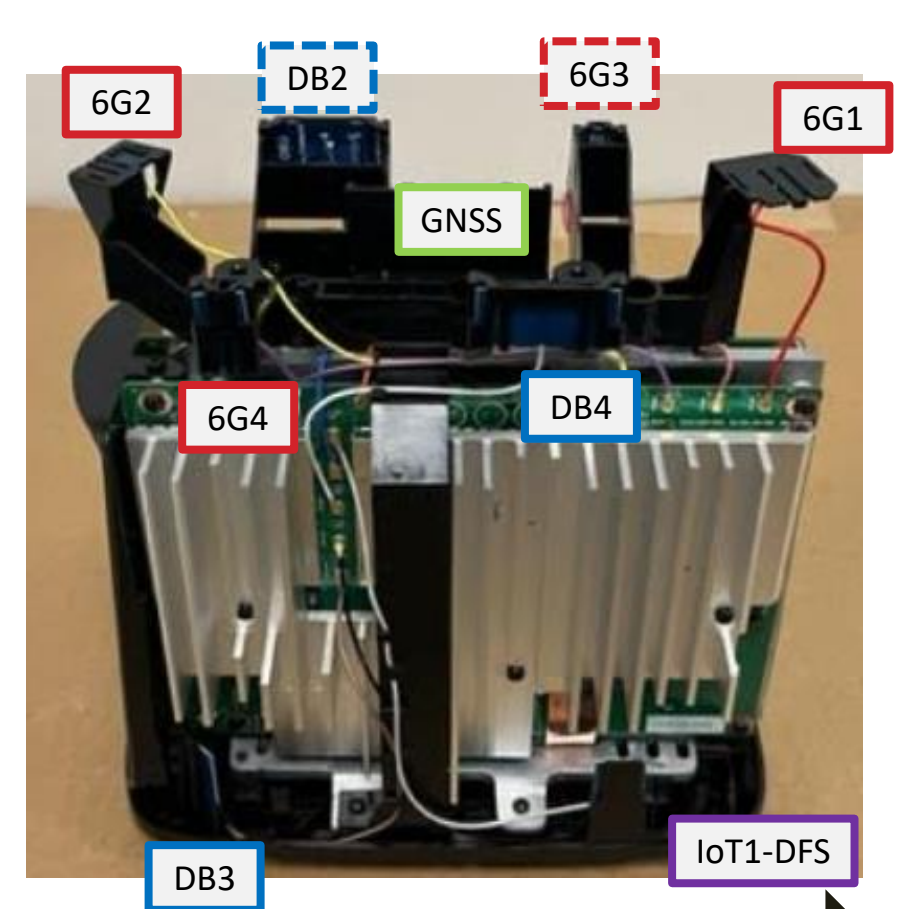
Heat Sink and PCBA



Front

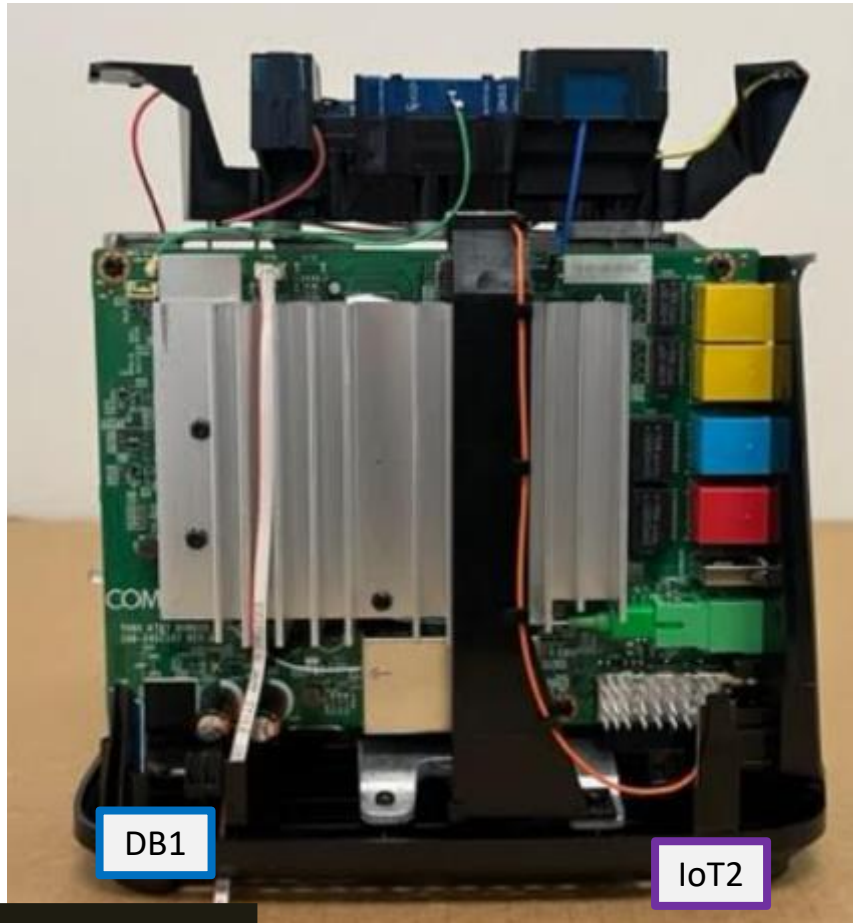


Front



Front

Heat Sink and PCBA



Front



Front



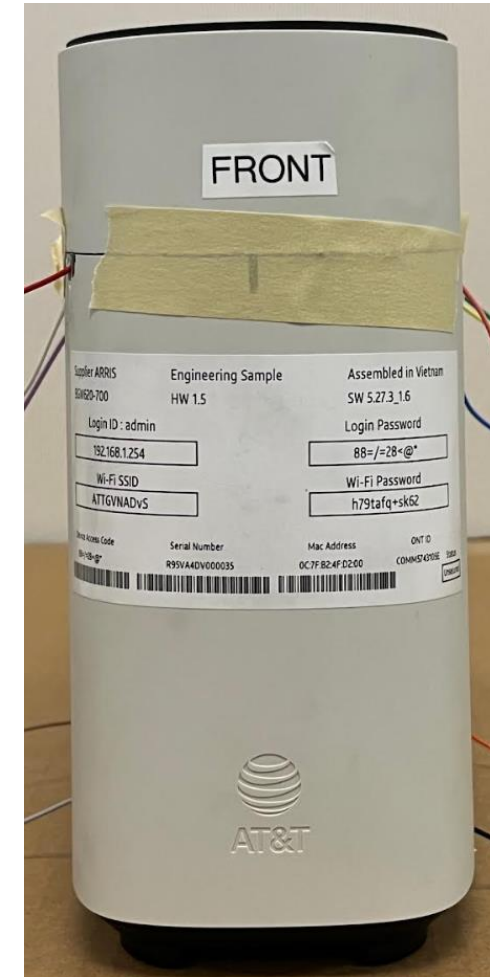
Front

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

DB1

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

DB2

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

DB3

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

DB4

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

DB1

Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
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 %

DB2

Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
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 %

DB3

Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
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 %

DB4

Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
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

6G1	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	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 %

6G2	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	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 %

6G3	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	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 %

6G4	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	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

GNSS	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	1575	4.219	5.586	72.99 %
IoT1	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	2400	4.716	6.386	68.07 %
	2450	4.592	6.383	66.20 %
	2500	4.480	6.320	65.47 %
	Average			66.58 %
IoT2	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	2400	3.765	5.306	70.13 %
	2450	3.578	5.314	67.06 %
	2500	3.457	5.375	64.30 %
	Average			67.16 %
DFS 5GHz	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	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 %
DFS 6 GHz	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	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

Frequency (MHz)	Degree		Gain (dBi)				Correlated Gain (dBi) - H-Pol
	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

Frequency (MHz)	Degree		Gain (dBi)				Correlated Gain (dBi)-V-Pol
	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

Frequency (MHz)	Degree		Gain (dBi)				UnCorrelated Gain (dBi) - H-Pol
	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

Frequency (MHz)	Degree		Gain (dBi)				UnCorrelated Gain (dBi)-V-Pol
	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

Frequency (MHz)	Degree		Gain (dBi)				Correlated Gain (dBi) - H-Pol
	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

Frequency (MHz)	Degree		Gain (dBi)				Correlated Gain (dBi)-V-Pol
	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

Frequency (MHz)	Degree		Gain (dBi)				UnCorrelated Gain (dBi) - H-Pol
	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

Frequency (MHz)	Degree		Gain (dBi)				UnCorrelated Gain (dBi)-V-Pol
	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

Frequency (MHz)	Degree		Gain (dBi)				Correlated Gain (dBi) - H-Pol
	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

Frequency (MHz)	Degree		Gain (dBi)				Correlated Gain (dBi)-V-Pol
	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

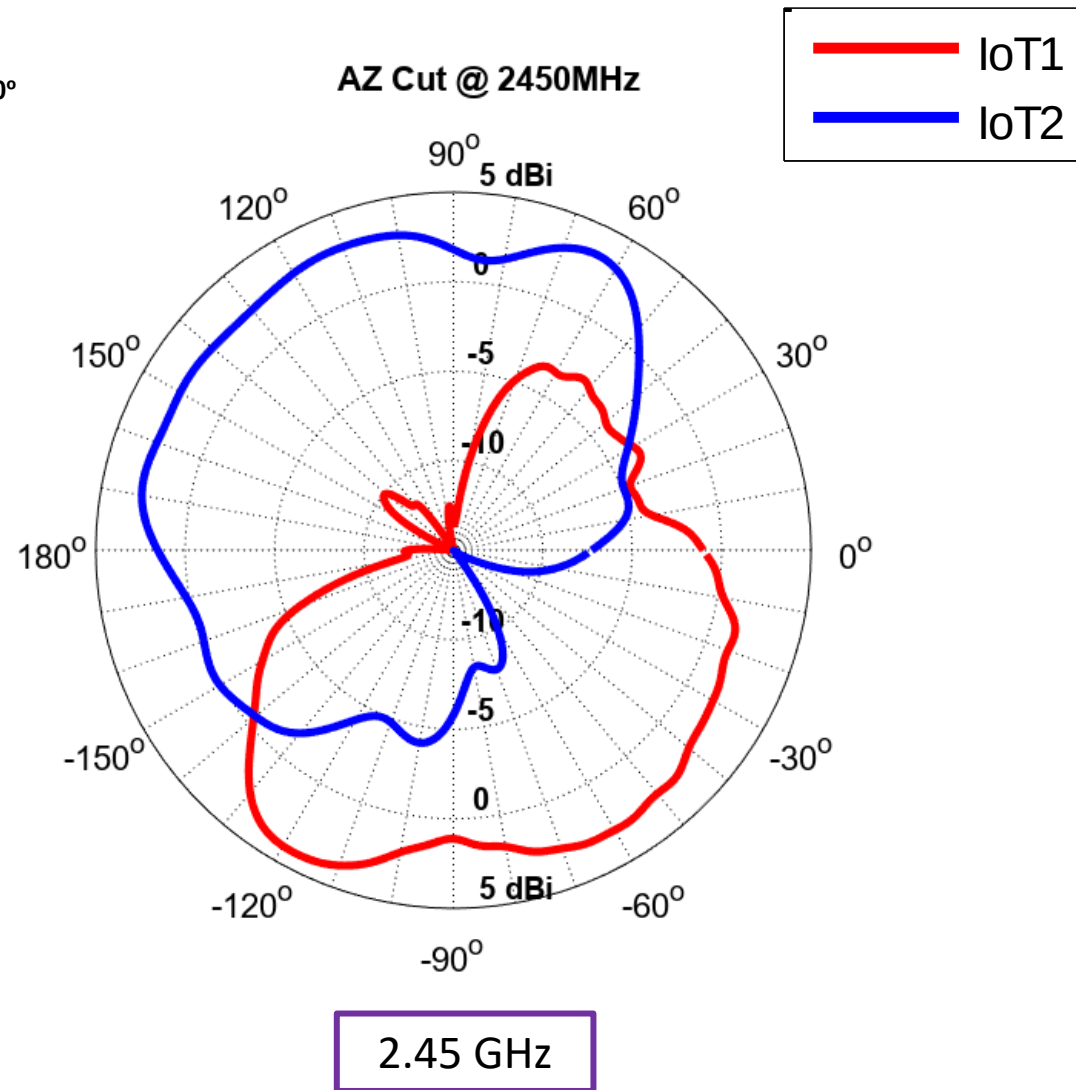
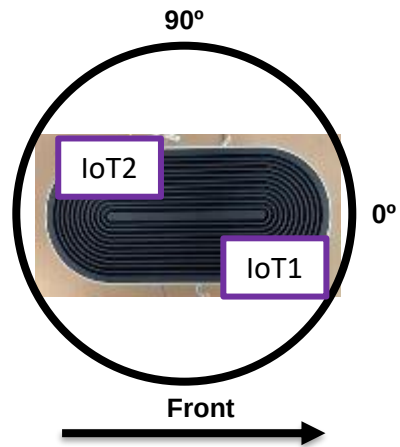
Worst Case

Frequency (MHz)	Degree		Gain (dBi)				UnCorrelated Gain (dBi) - H-Pol
	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

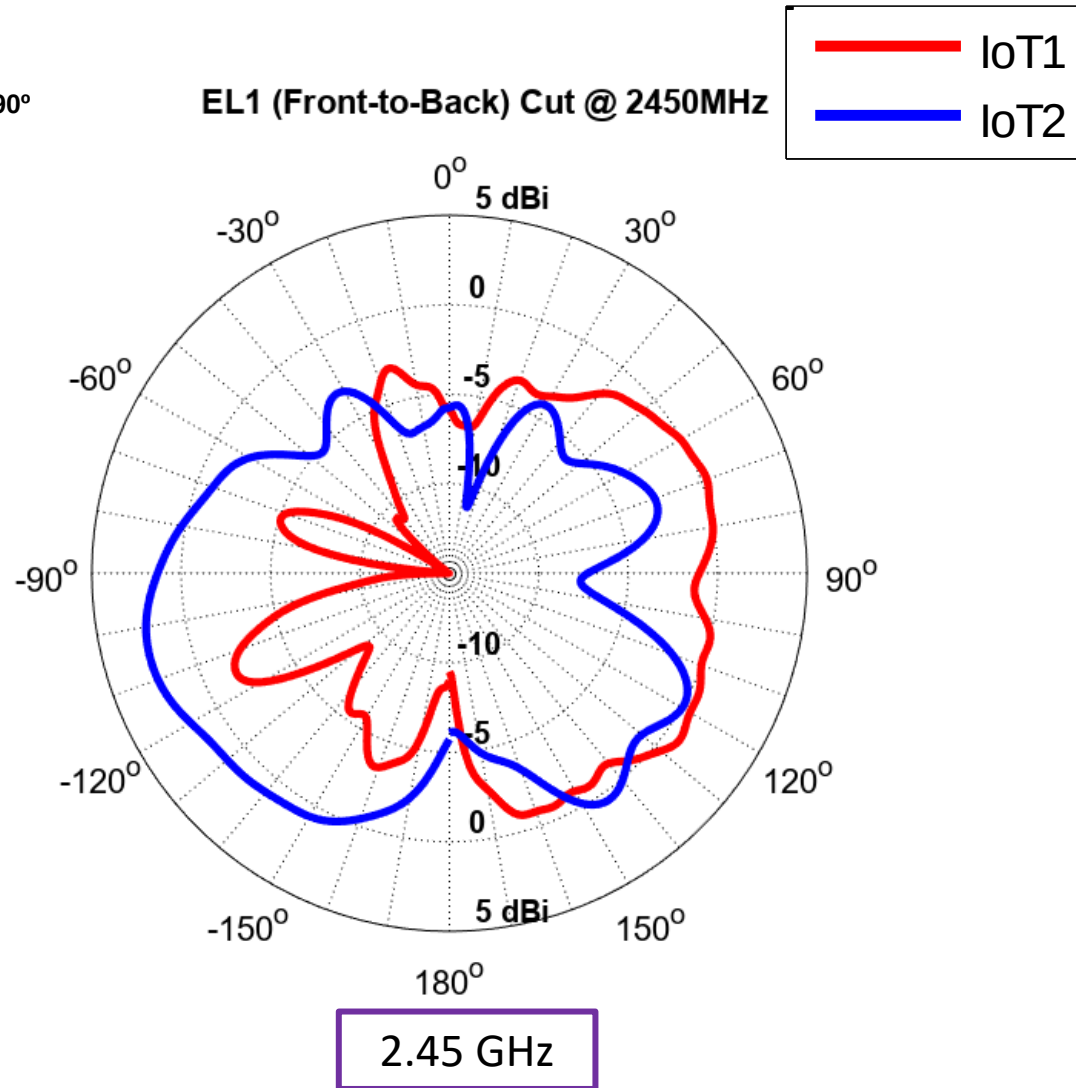
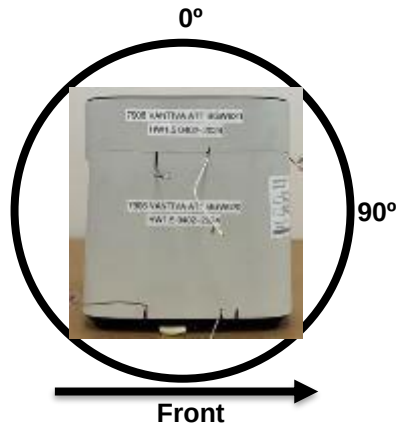
Frequency (MHz)	Degree		Gain (dBi)				UnCorrelated Gain (dBi)-V-Pol
	Theta	Phi	6G1	6G2	6G3	6G4	
5925	87	18	-8.51	-8.26	2.94	4.90	1.26
6300	90	9	-10.33	-28.37	5.03	4.29	1.74
6500	91	10	-11.80	-15.60	4.54	4.37	1.52
6800	96	22	-18.64	-7.21	3.73	3.99	1.03
7125	92	11	-21.43	-15.31	3.94	5.09	1.57

Azimuth Cut - Power Sum

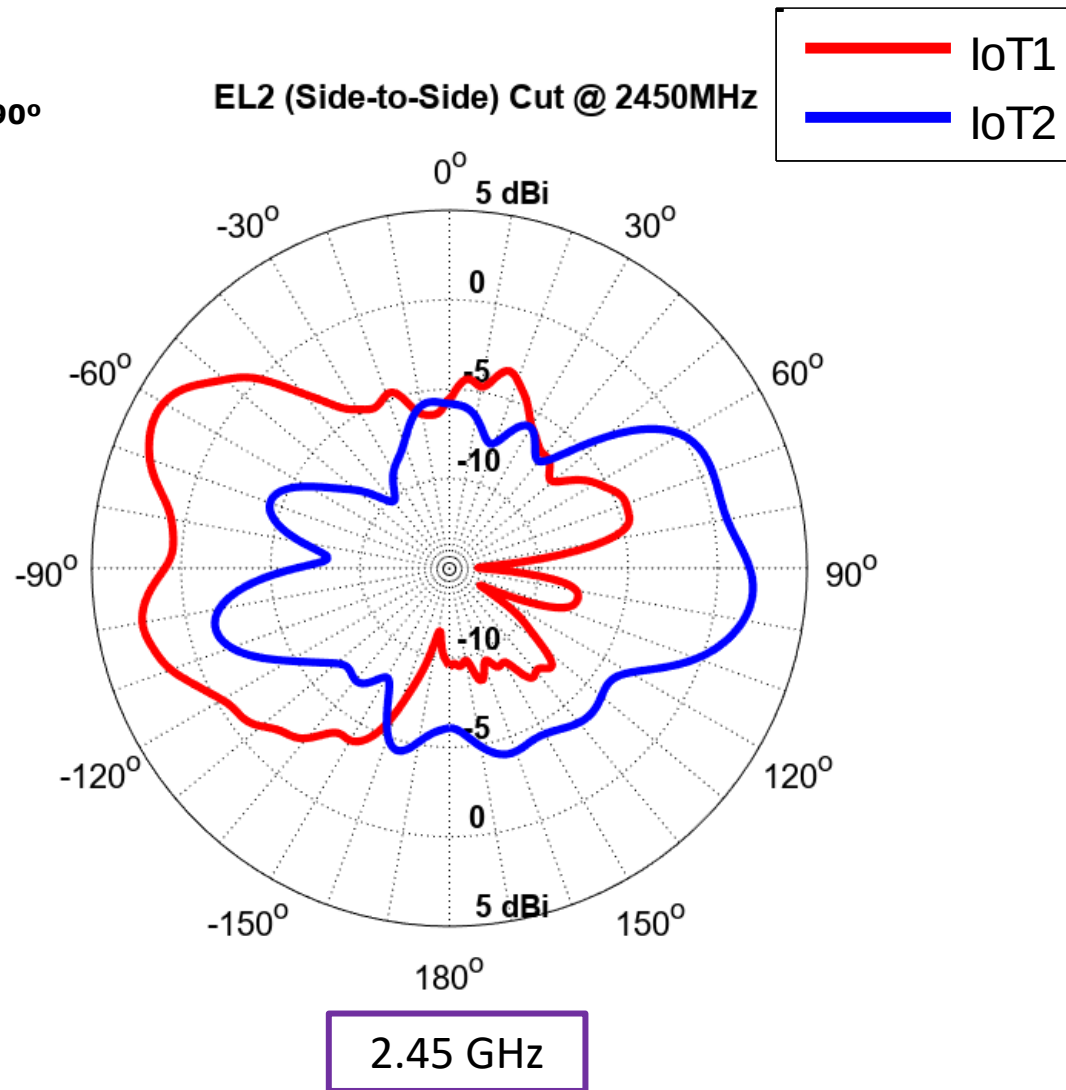
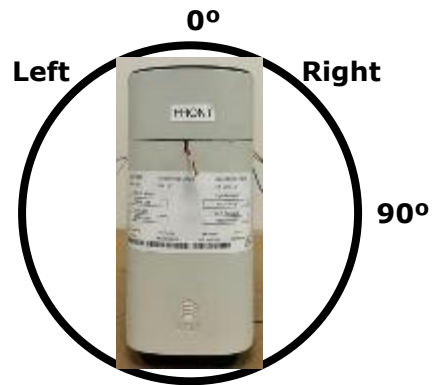
System Coverage – IoT Antennas



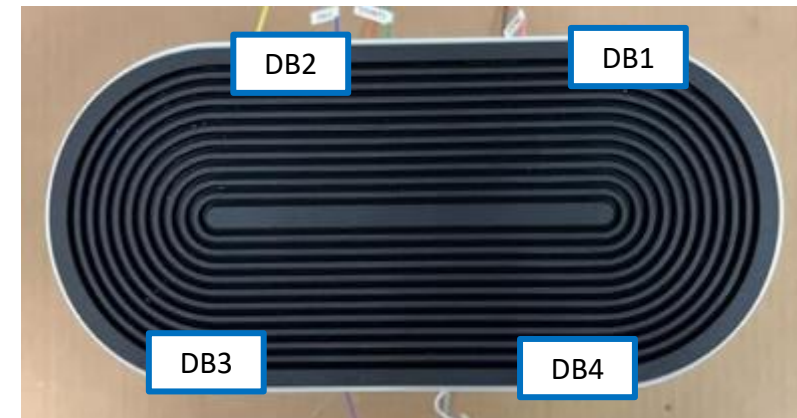
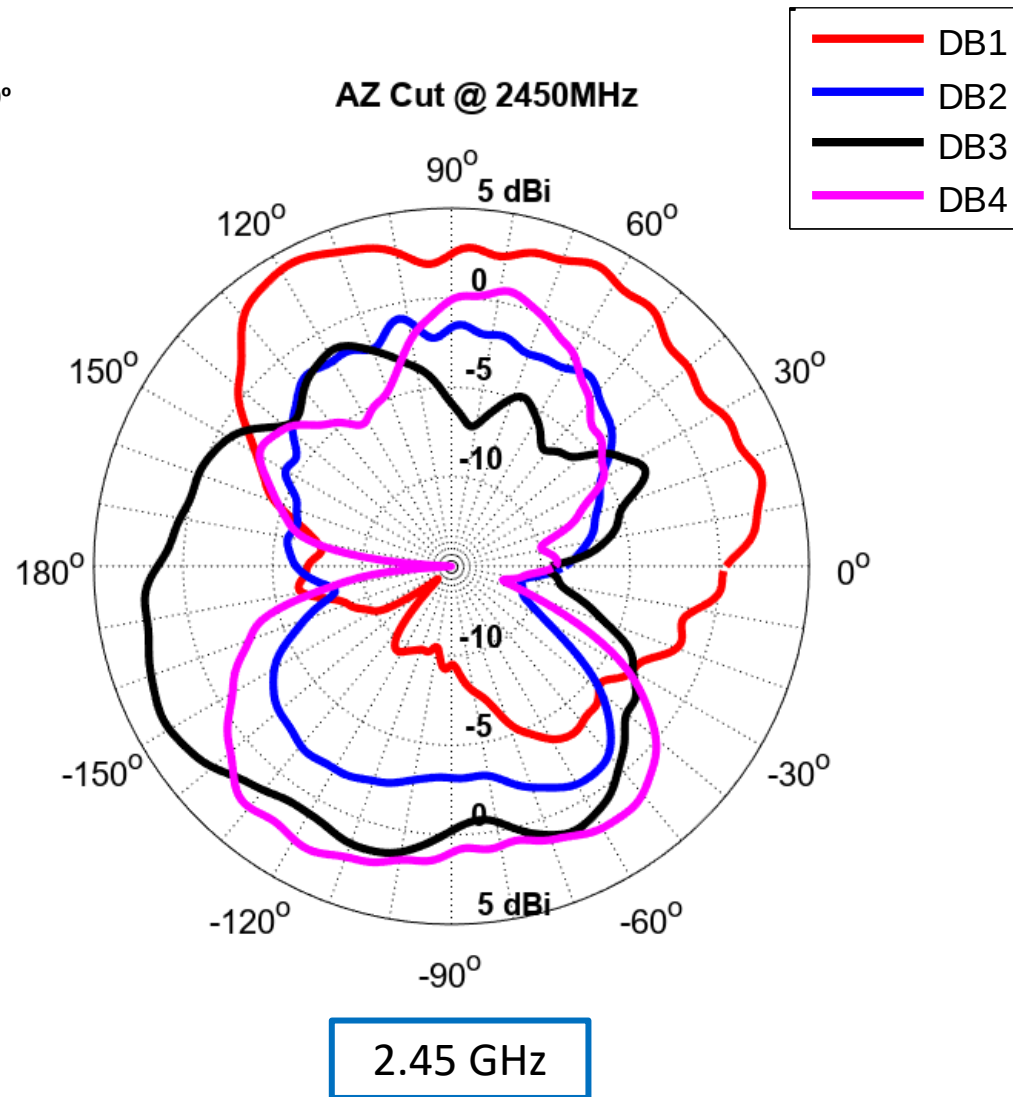
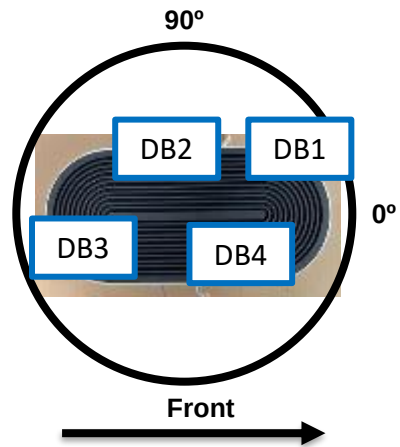
Elevation (Front to Back) Cut - Power Sum System Coverage – IoT Antennas



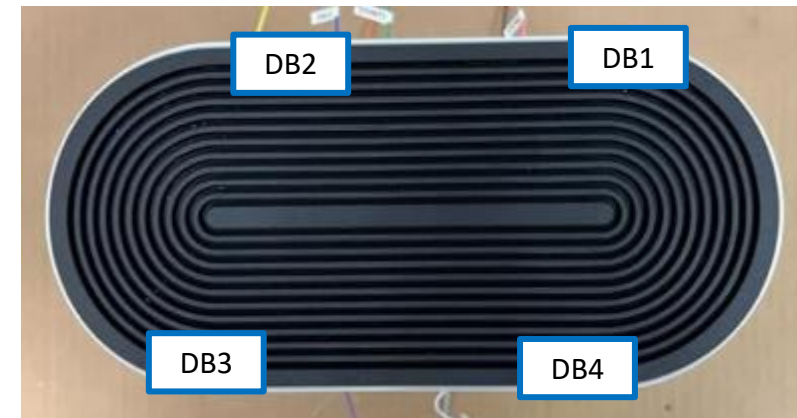
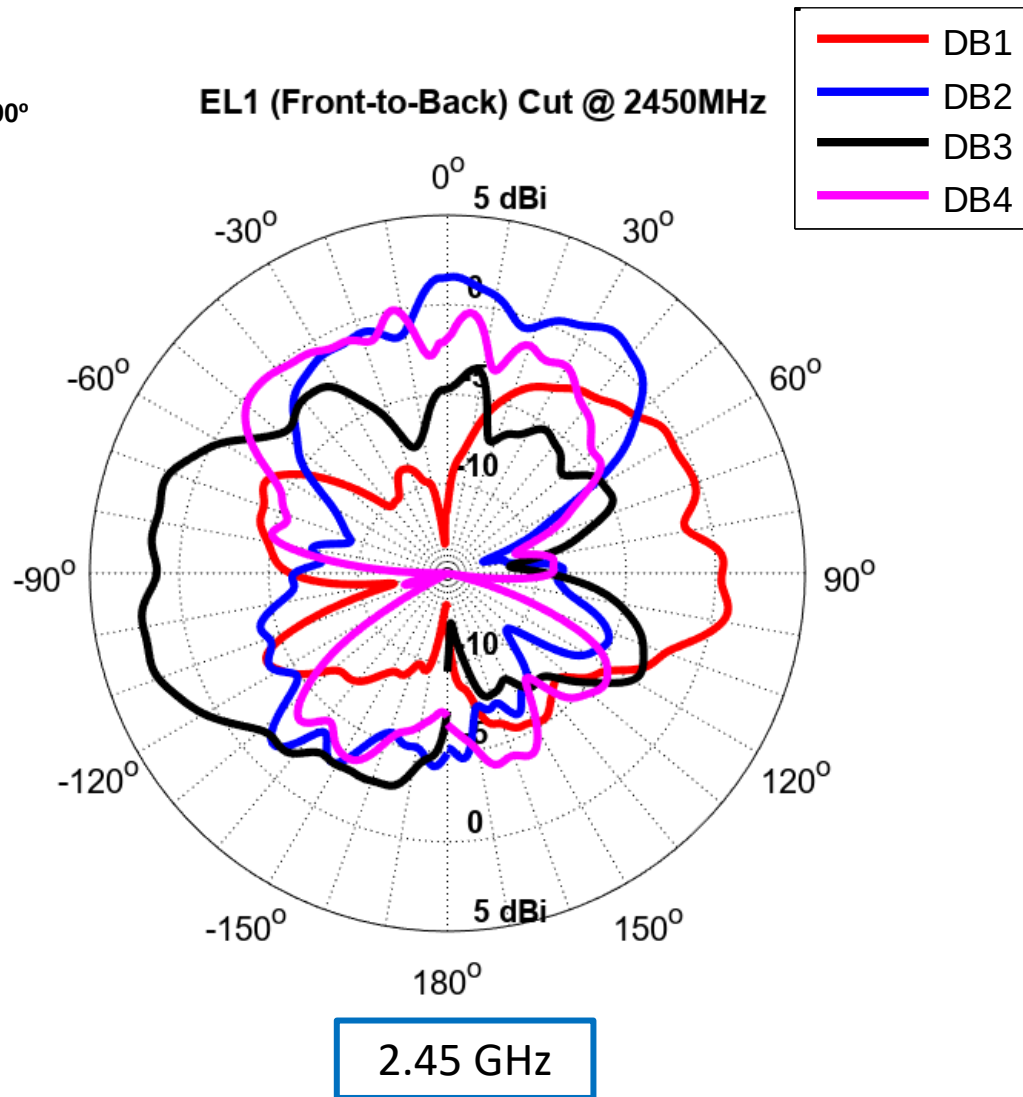
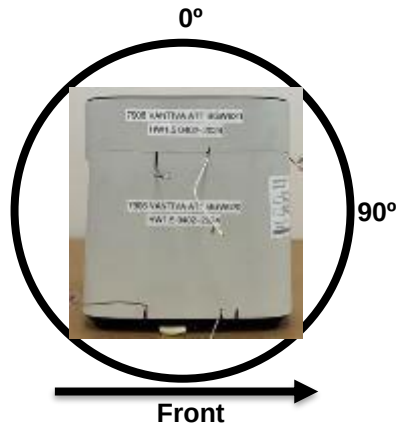
Elevation (Side to Side) Cut - Power Sum System Coverage – IoT Antennas



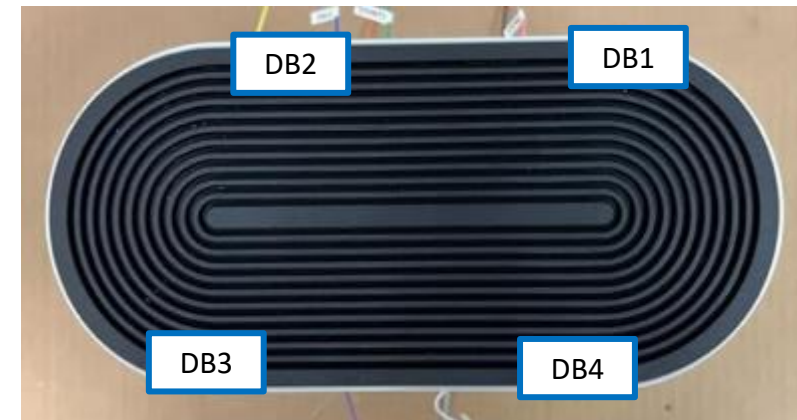
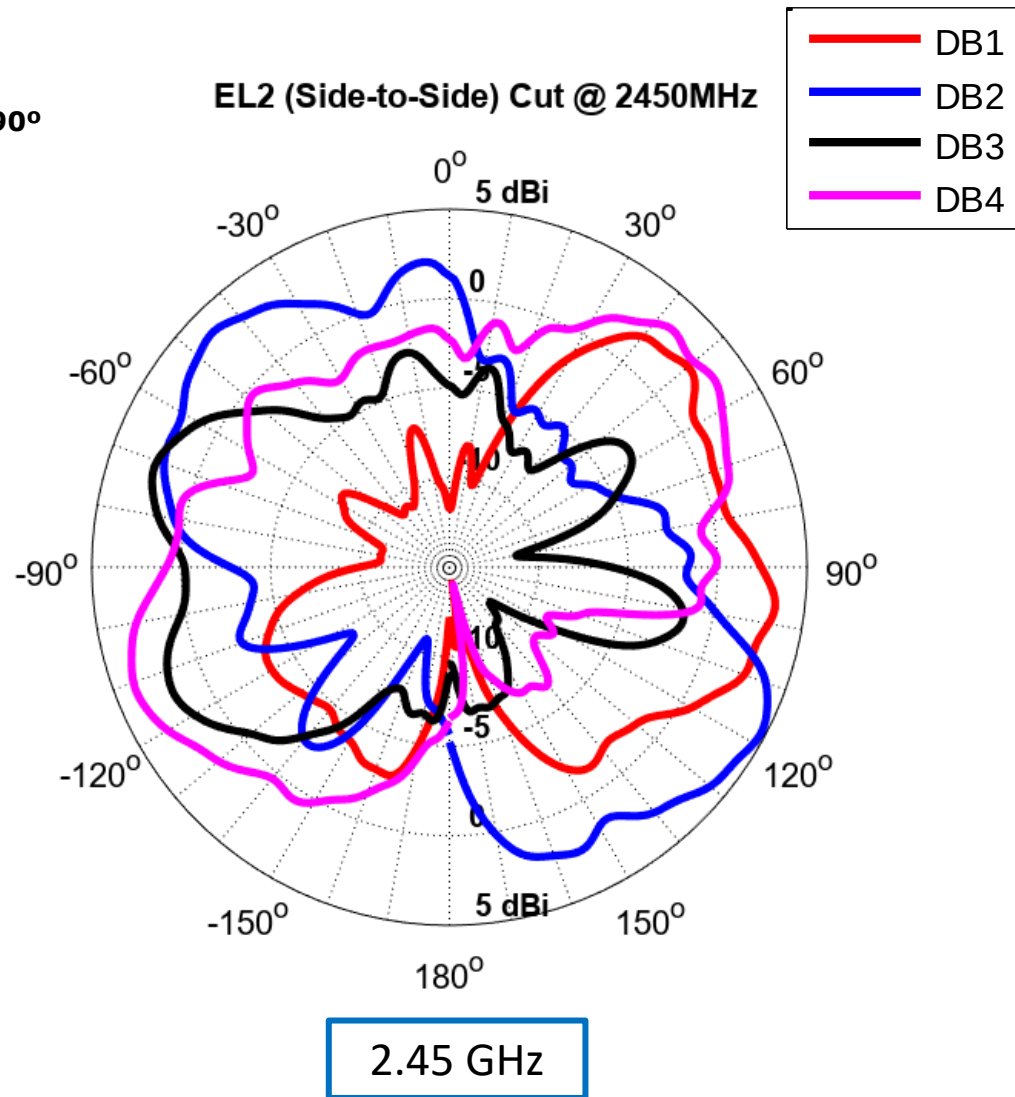
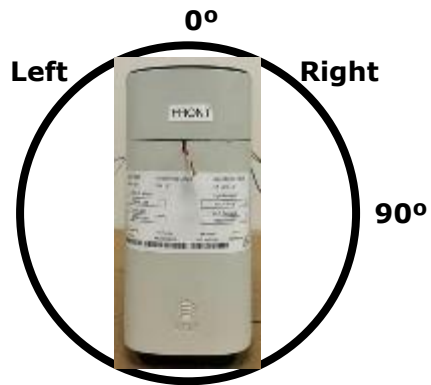
Azimuth Cut - Power Sum System Coverage – DB Antennas



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

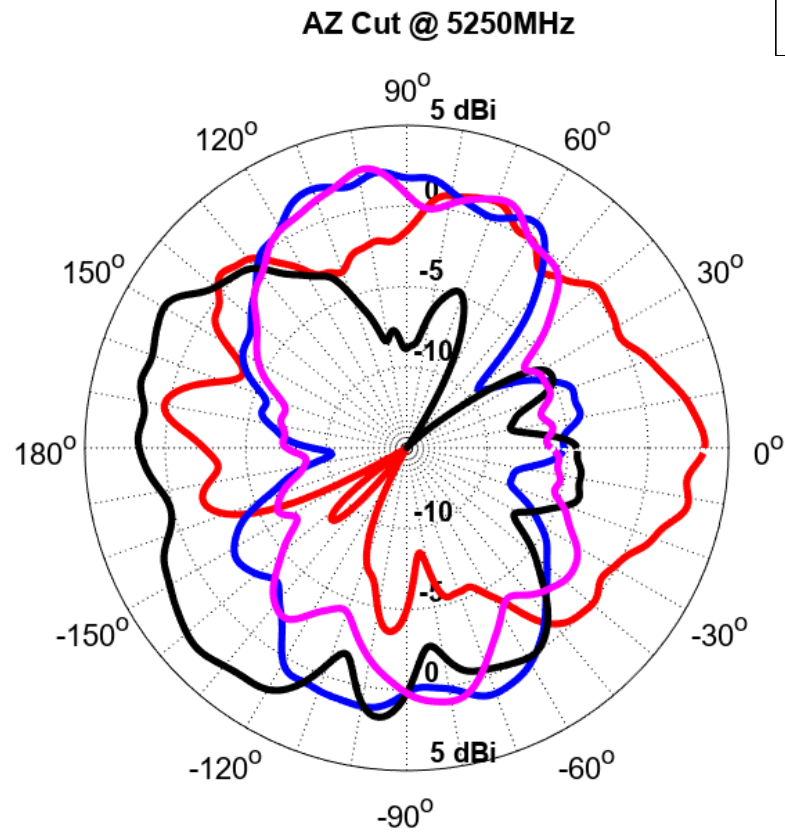
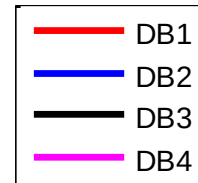


Elevation (Side to Side) Cut - Power Sum System Coverage – DB Antennas

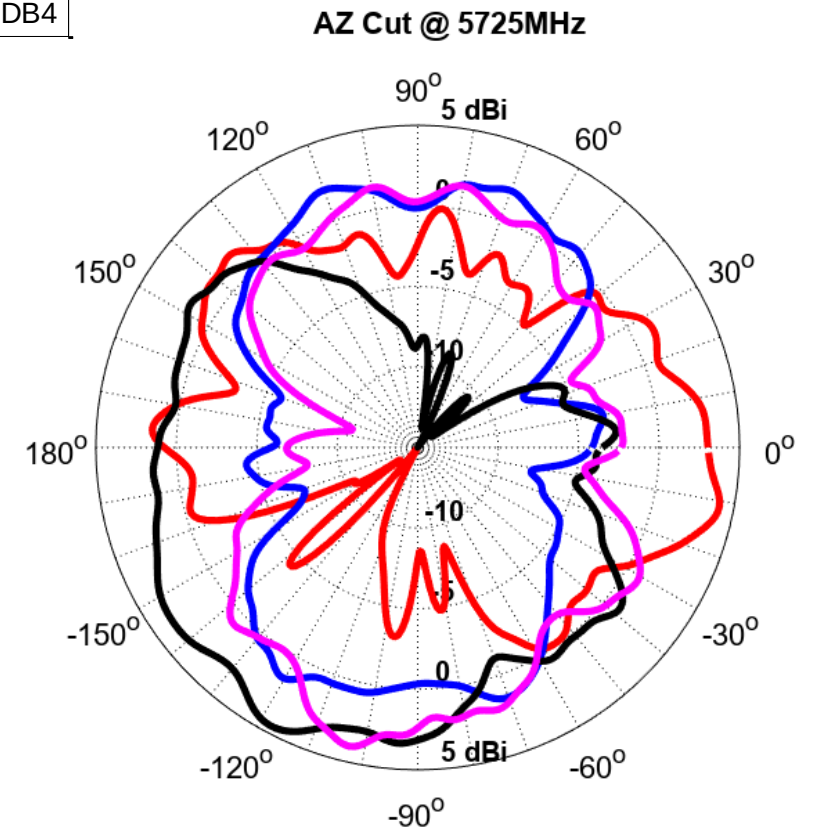
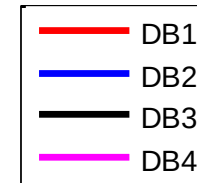
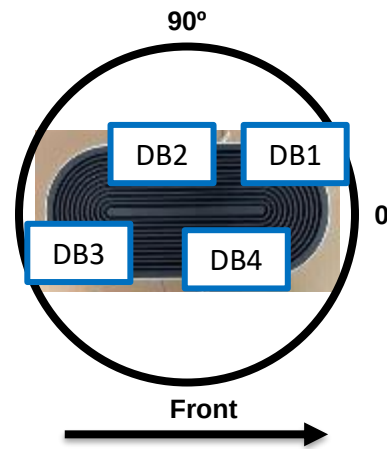


Azimuth Cut - Power Sum

System Coverage – DB Antennas



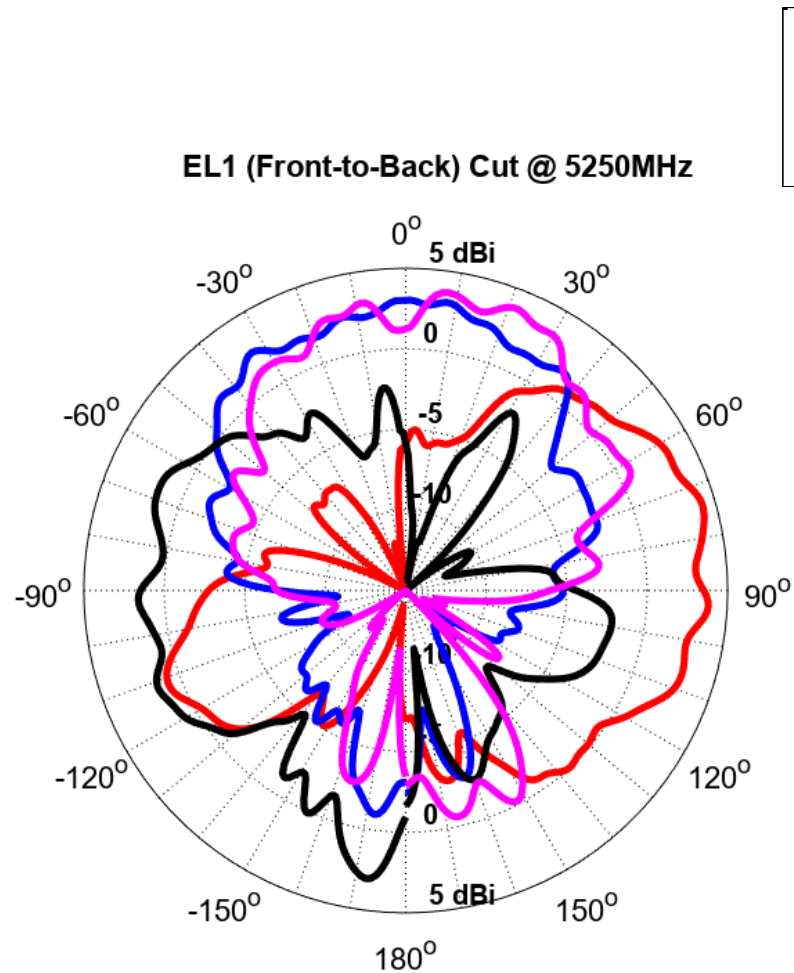
Dual Band – 5.25 GHz



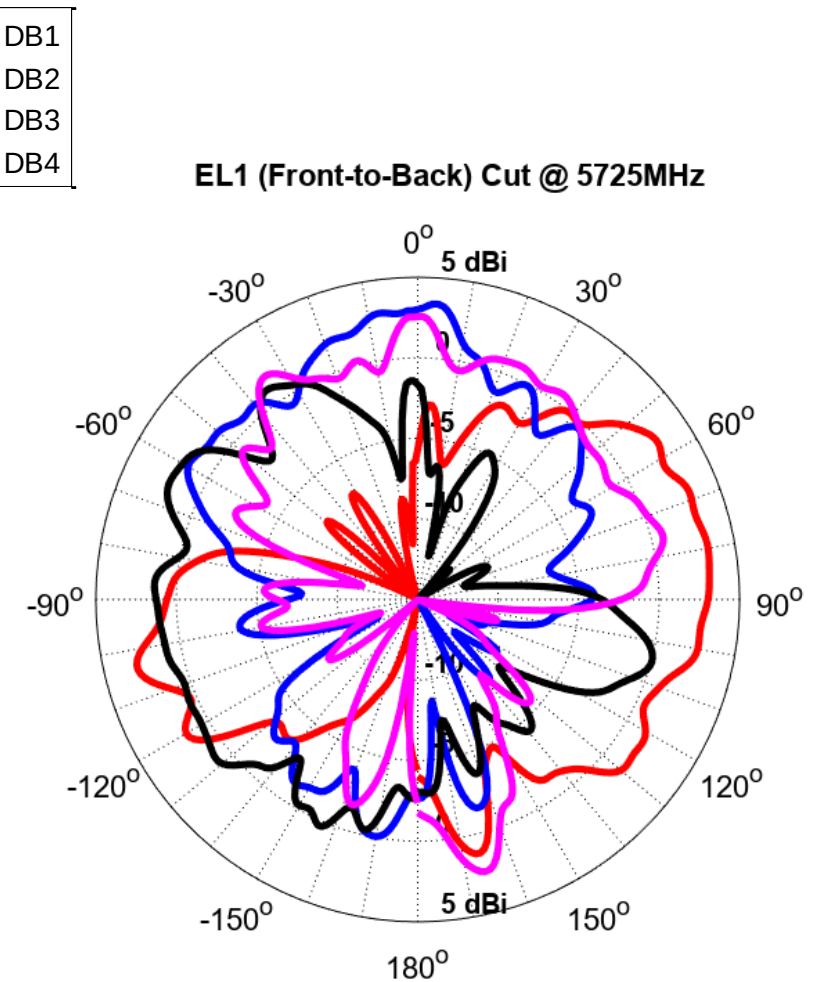
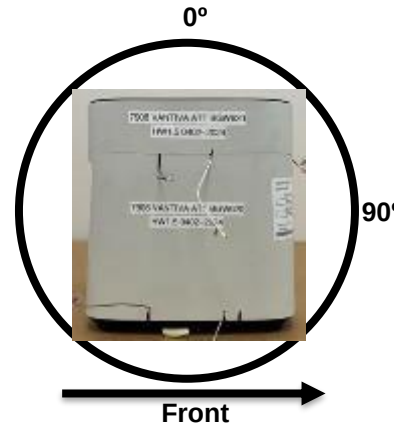
Dual Band – 5.725 GHz



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



Dual Band – 5.25 GHz

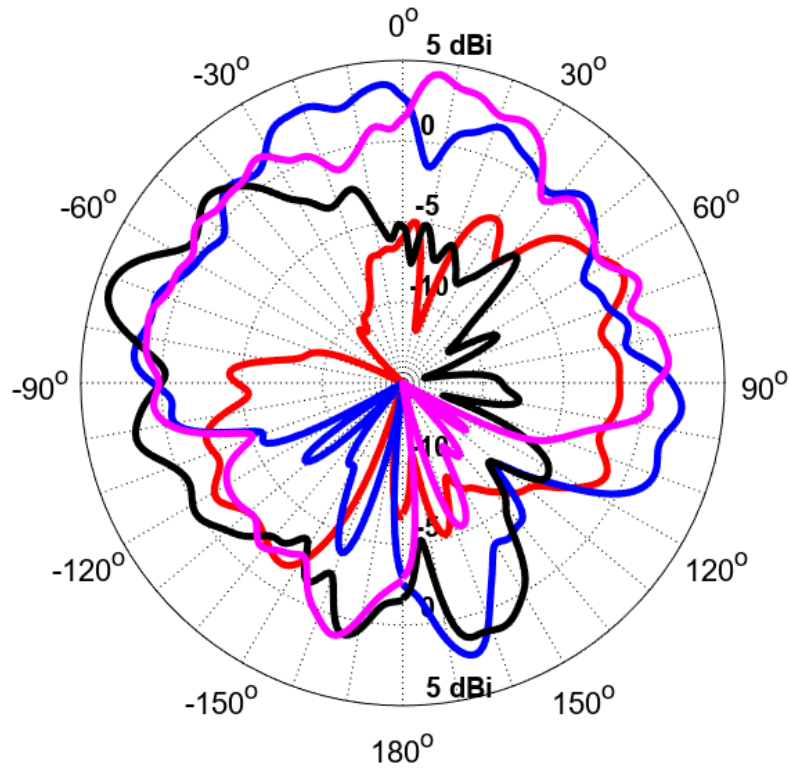


Dual Band – 5.725 GHz

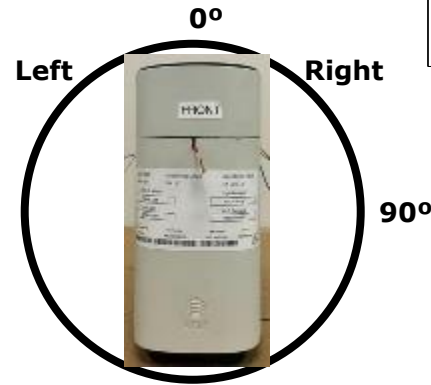
Elevation (Side to Side) Cut - Power Sum System Coverage – DB Antennas



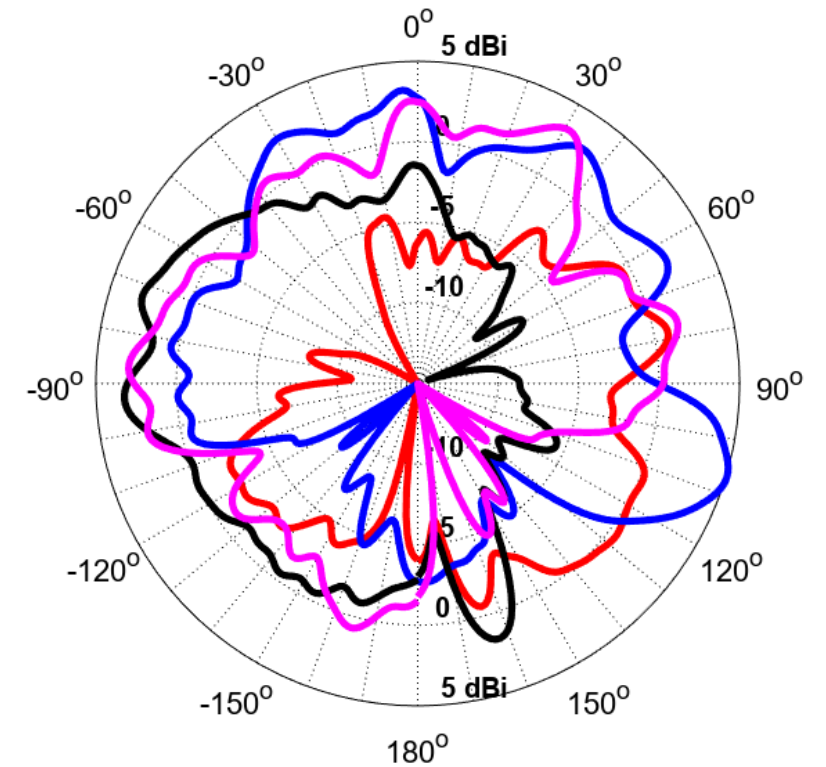
EL2 (Side-to-Side) Cut @ 5250MHz



Dual Band – 5.25 GHz



EL2 (Side-to-Side) Cut @ 5725MHz

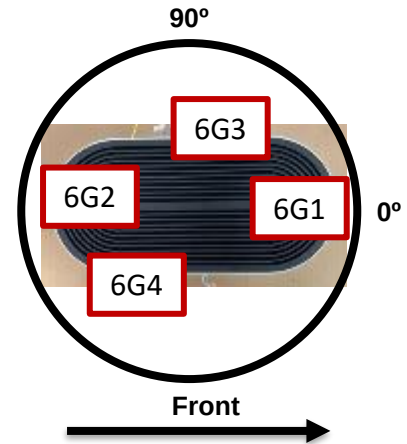


Dual Band – 5.725 GHz

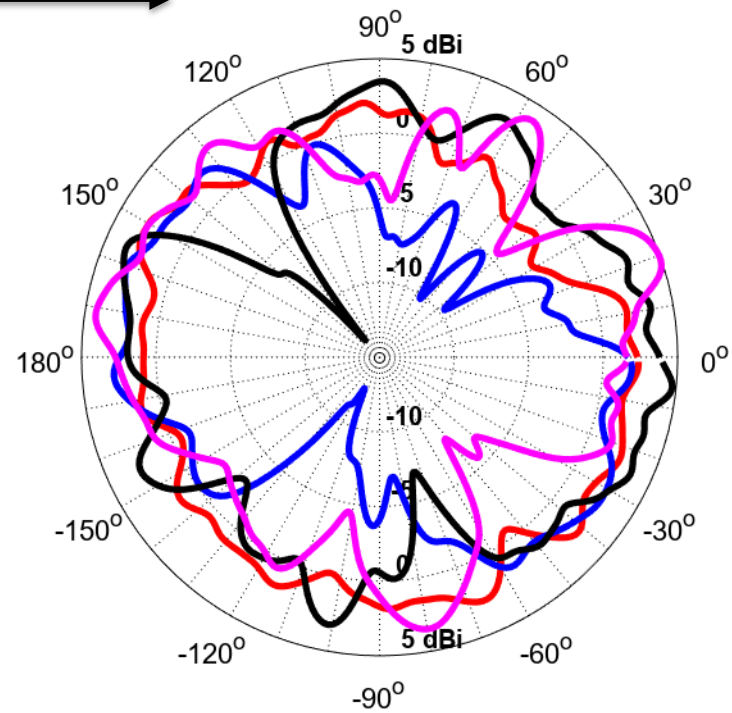


Azimuth Cut - Power Sum

System Coverage – 6 GHz Antennas

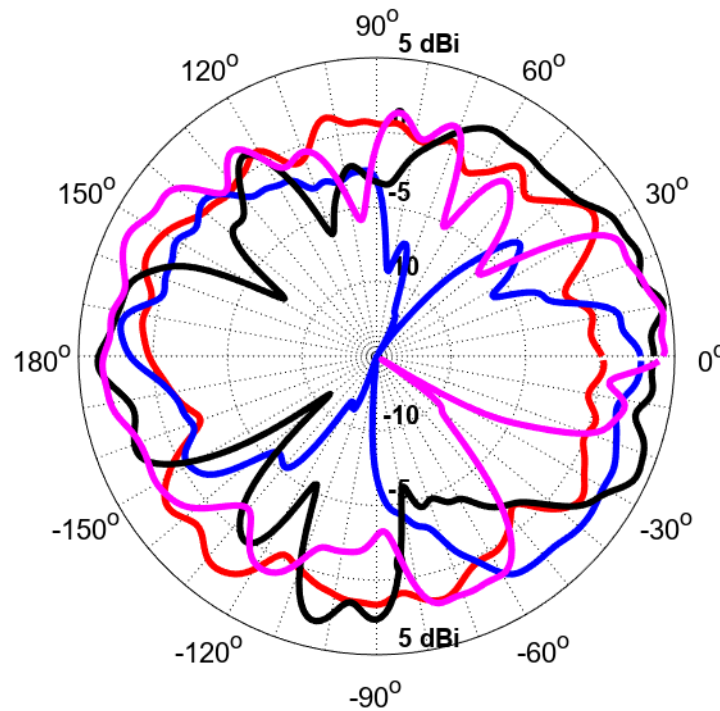


AZ Cut @ 5925MHz



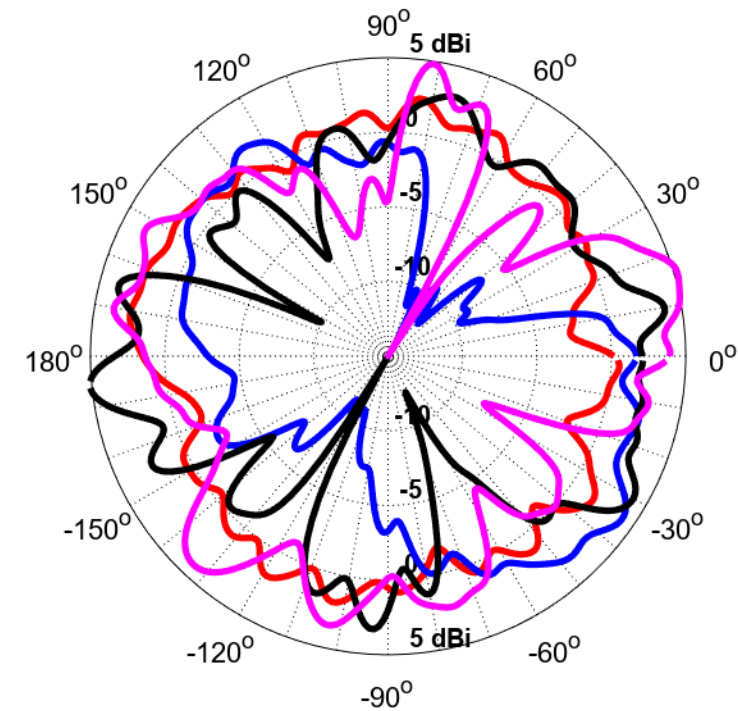
5.925 GHz

AZ Cut @ 6500MHz



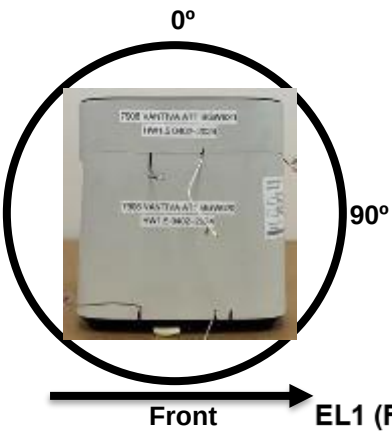
6.5 GHz

AZ Cut @ 7125MHz

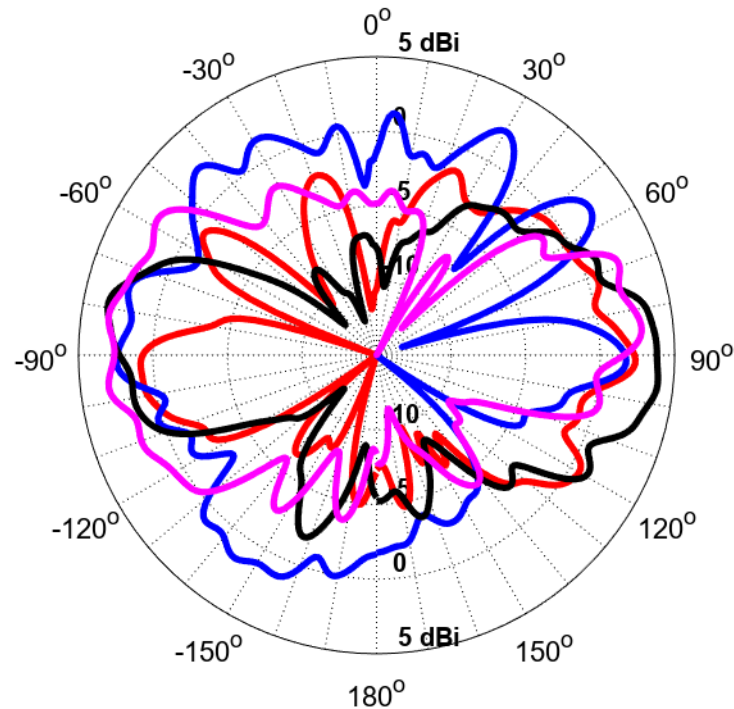
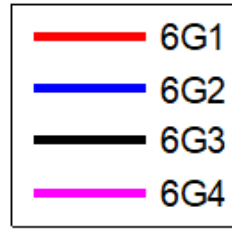


7.125 GHz

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

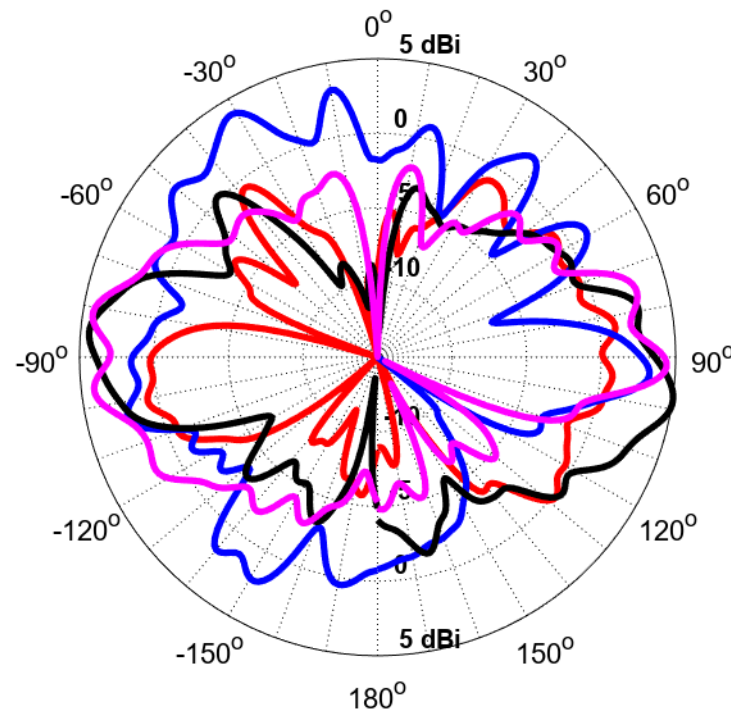
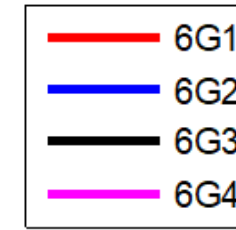


EL1 (Front-to-Back) Cut @ 5925MHz



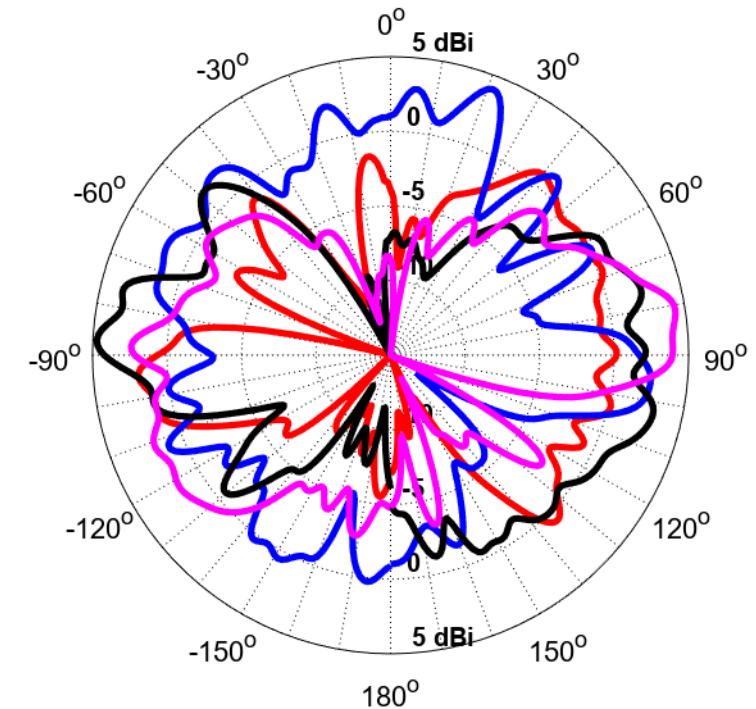
5.925 GHz

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



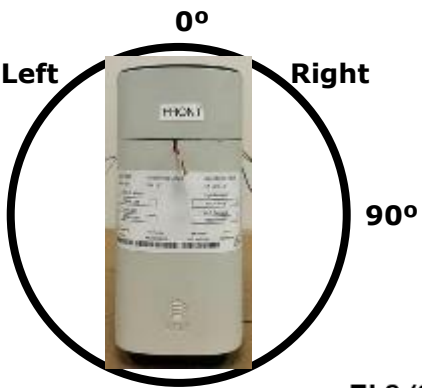
6.5 GHz

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

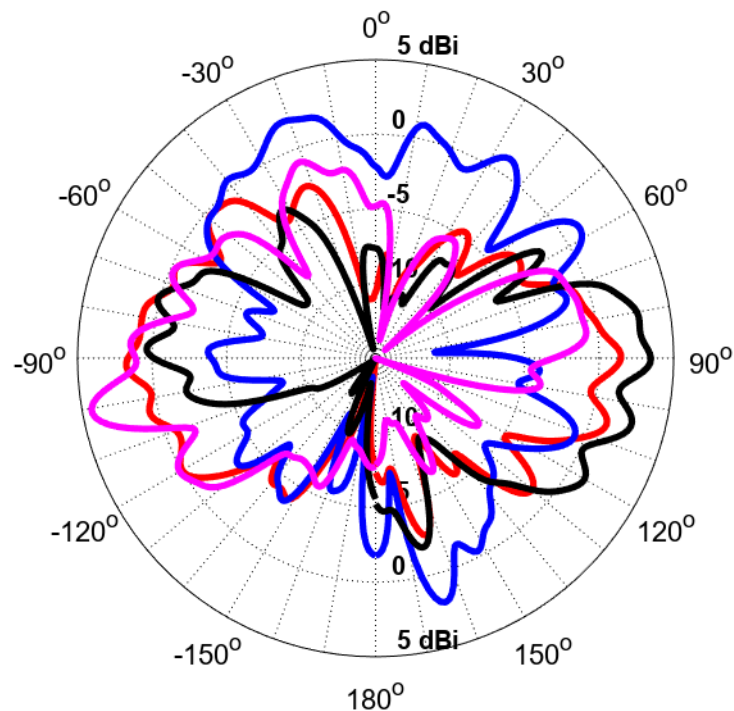


7.125 GHz

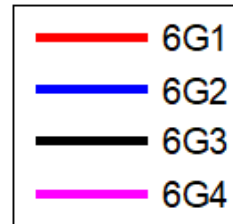
Elevation (Side to Side) Cut - Power Sum System Coverage – 6 GHz Antennas



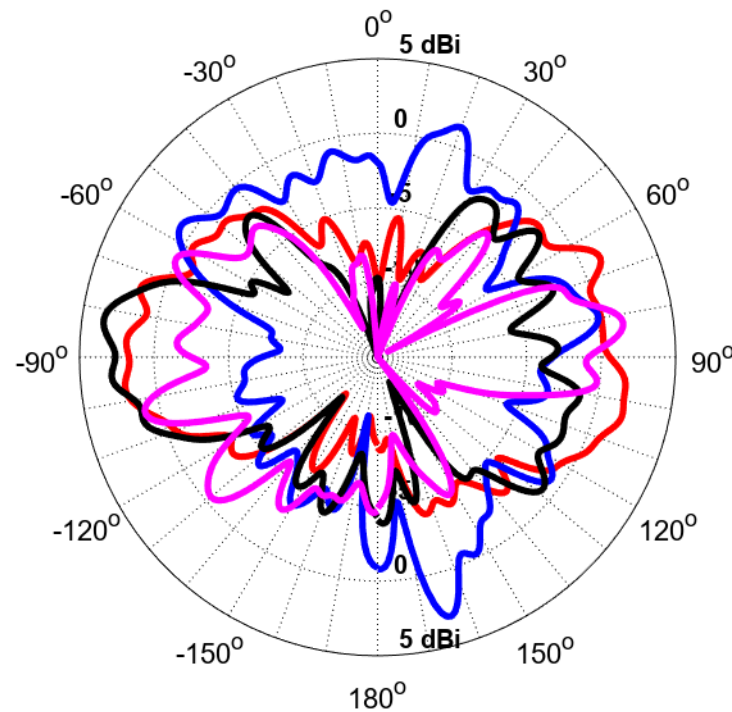
EL2 (Side-to-Side) Cut @ 5925MHz



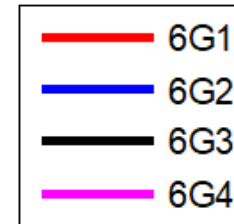
5.925 GHz



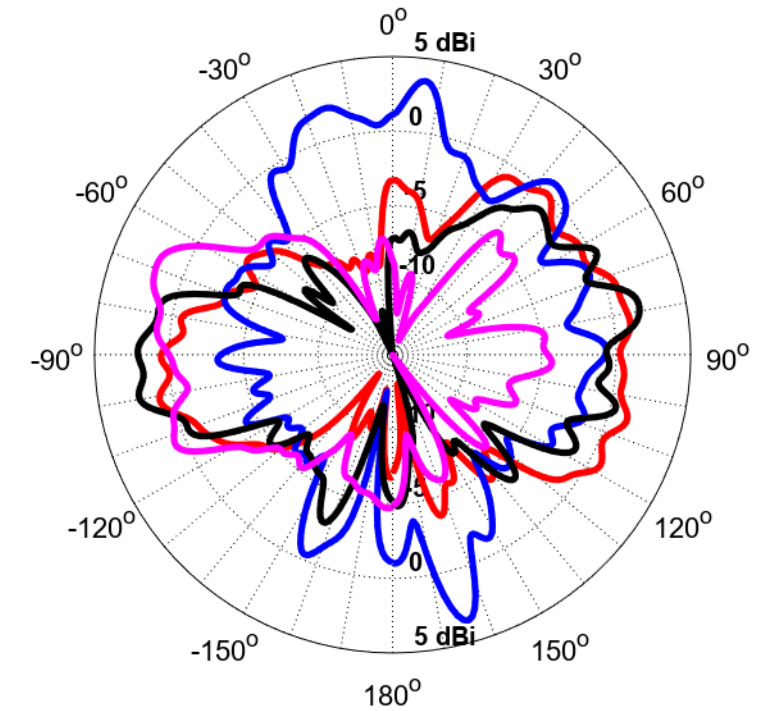
EL2 (Side-to-Side) Cut @ 6500MHz



6.5 GHz



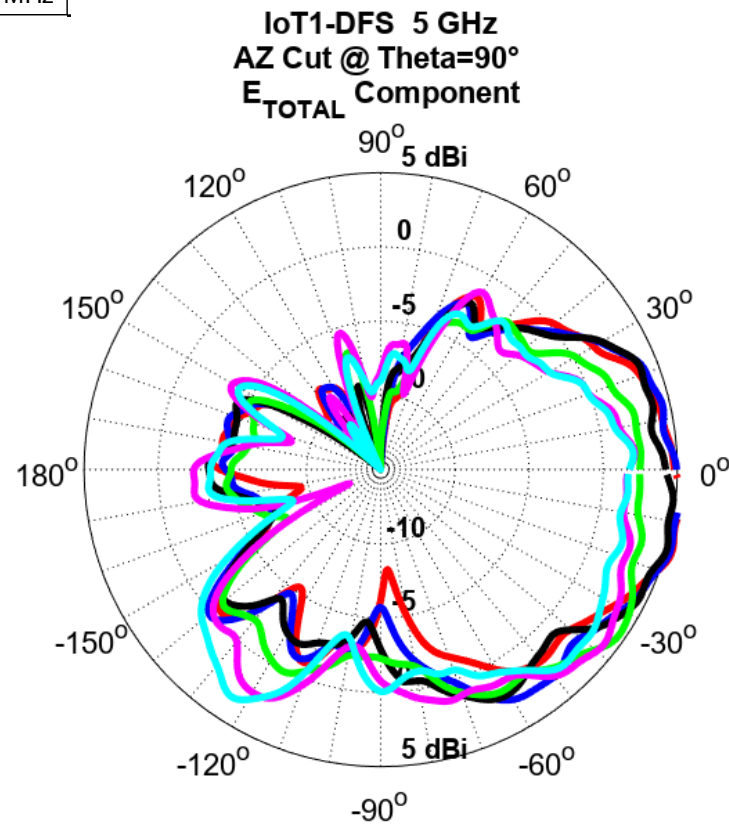
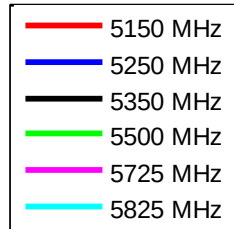
EL2 (Side-to-Side) Cut @ 7125MHz



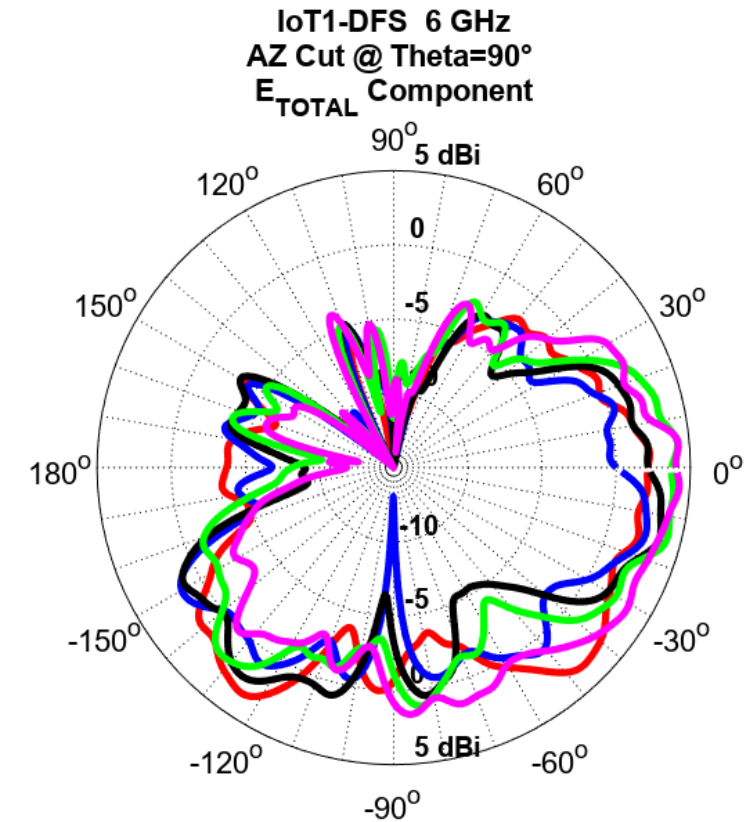
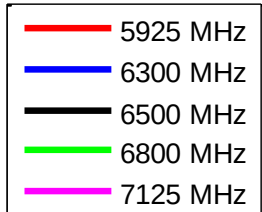
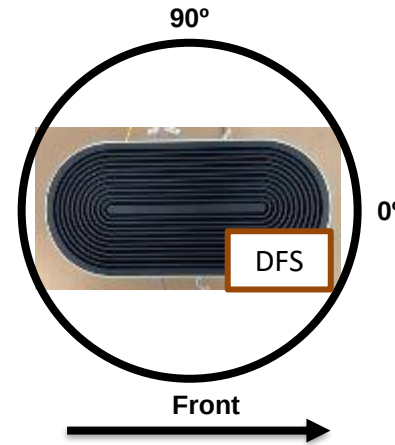
7.125 GHz

Azimuth Cut - Power Sum

DFS Antenna



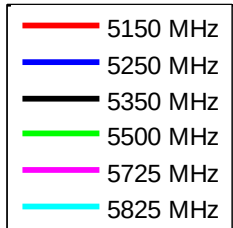
DFS-5 GHz



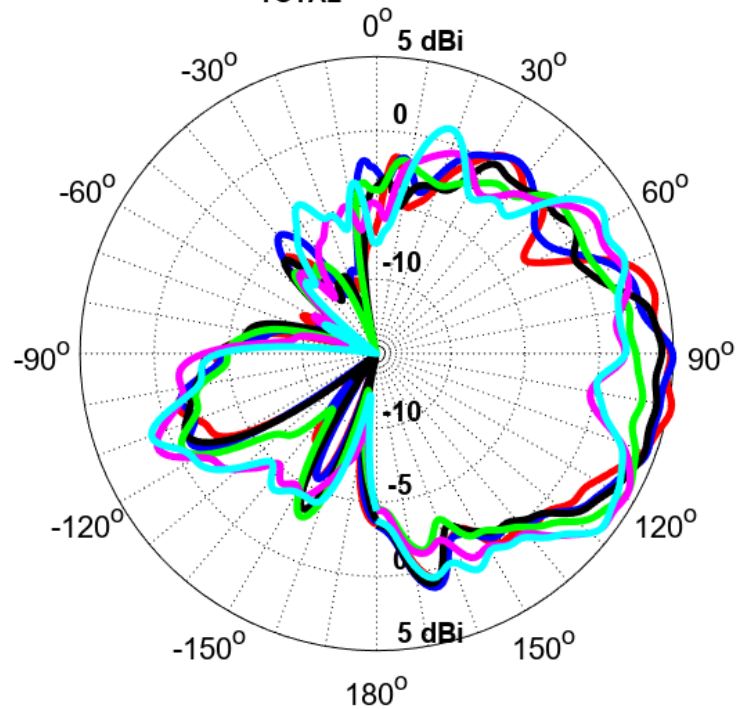
DFS-6 GHz

Elevation (Front to Back) Cut - Power Sum

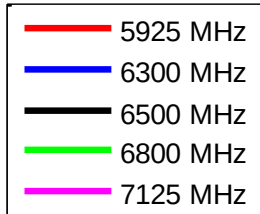
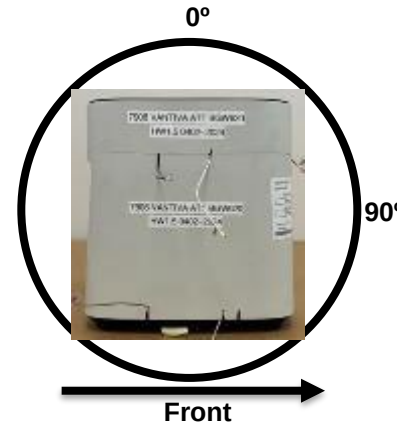
DFS Antenna



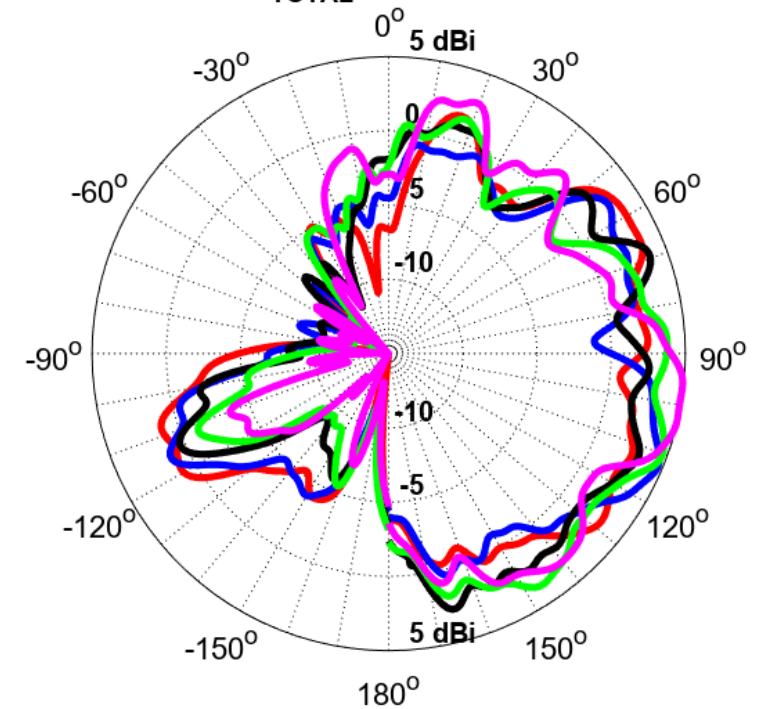
IoT1-DFS 5 GHz
EL1 (Front-to-Back) Cut @ $\Phi=0^\circ$
 E_{TOTAL} Component



DFS-5 GHz



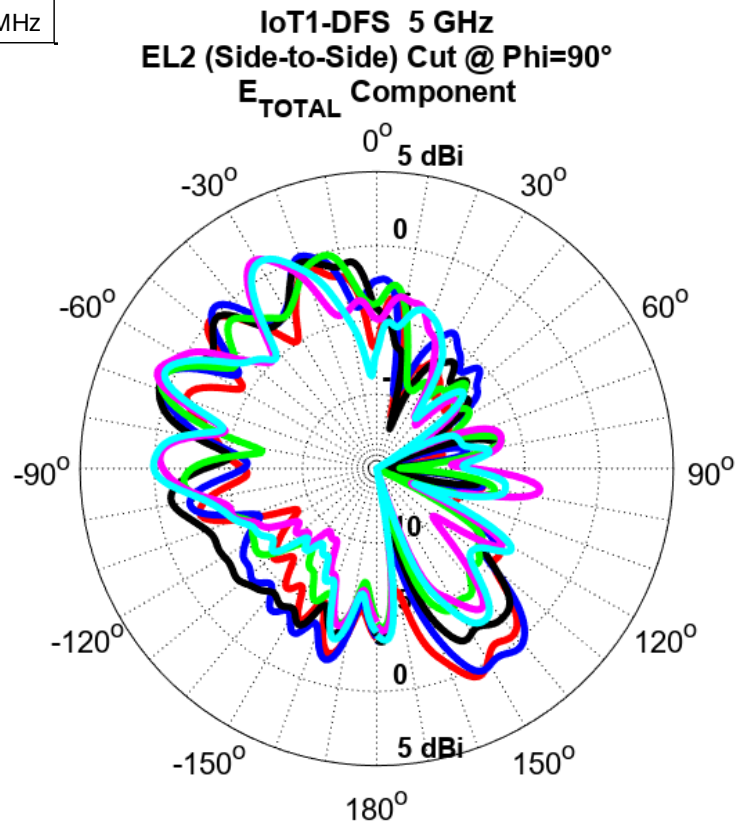
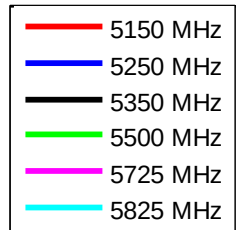
IoT1-DFS 6 GHz
EL1 (Front-to-Back) Cut @ $\Phi=0^\circ$
 E_{TOTAL} Component



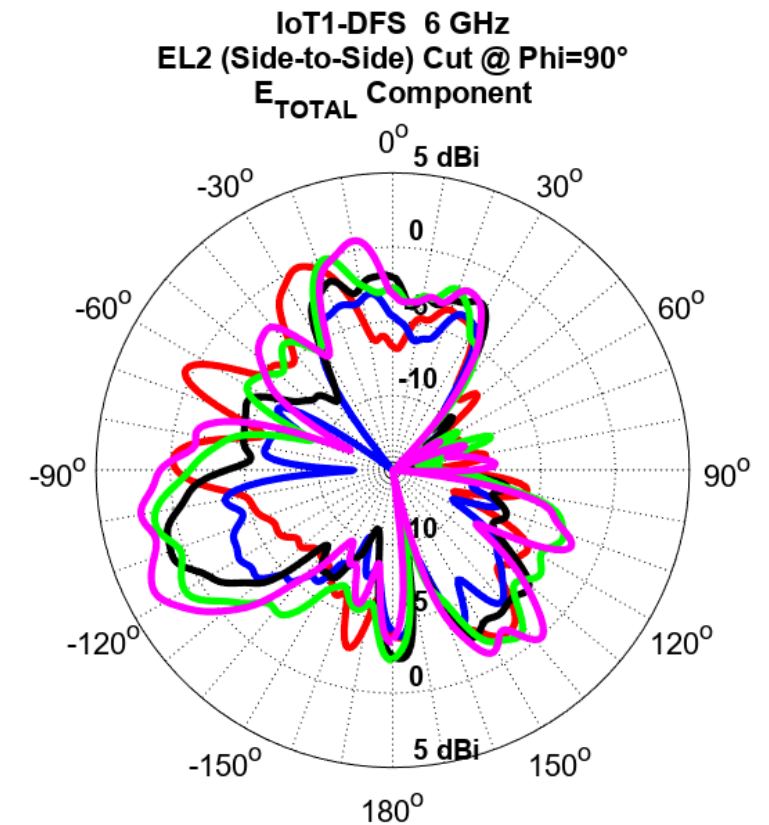
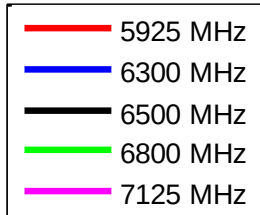
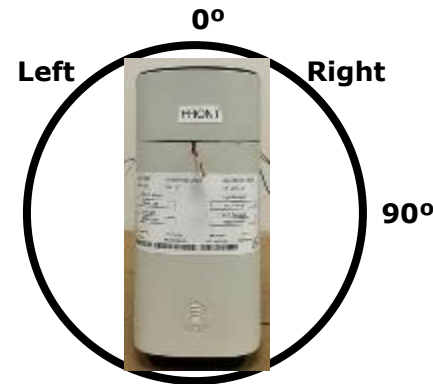
DFS-6 GHz

Elevation (Side to Side) Cut - Power Sum

DFS Antenna

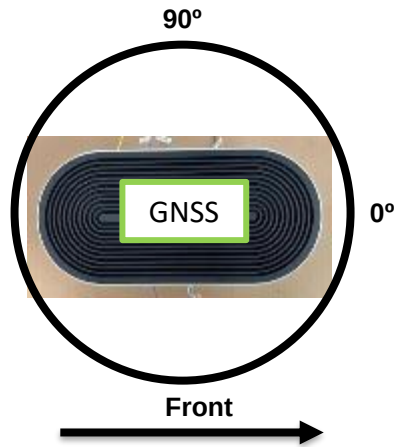


DFS-5 GHz

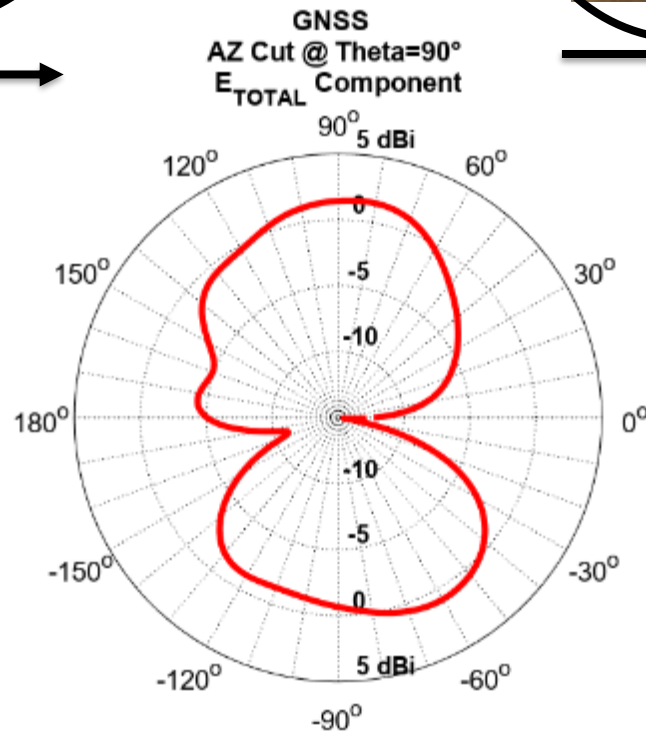


DFS-6 GHz

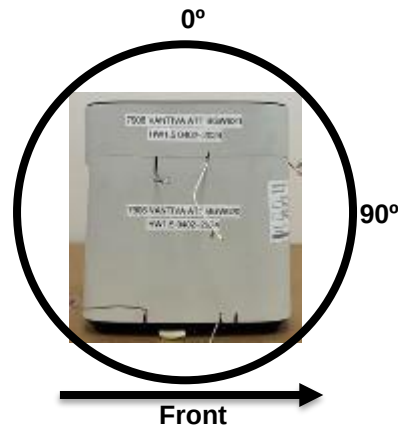
GNSS Antenna Power Sum Gain Patterns



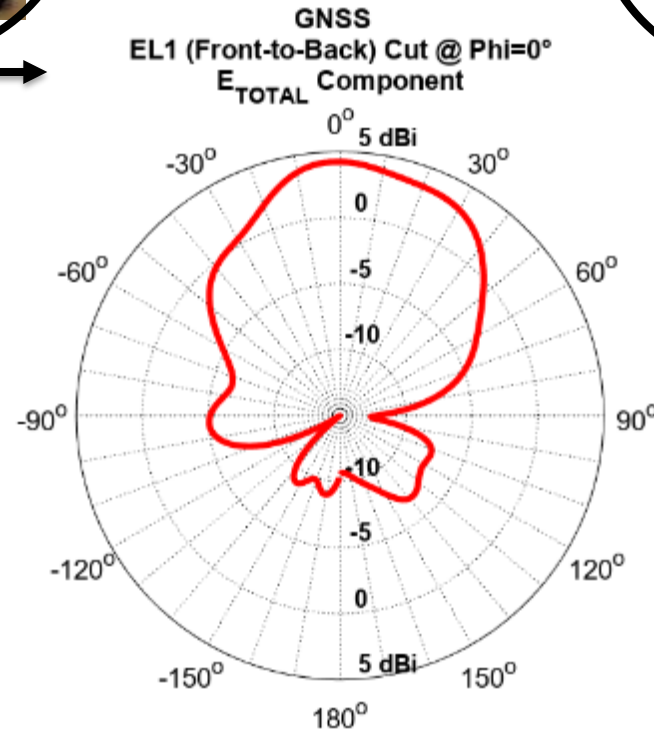
1575 MHz



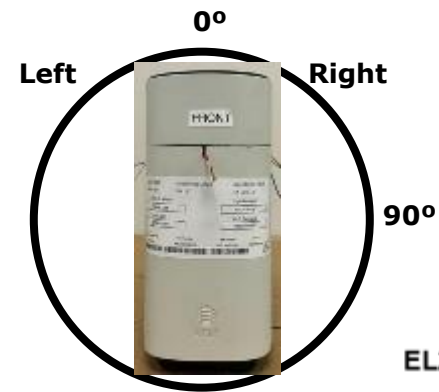
Azimuth Cut ($\theta = 90^\circ$)



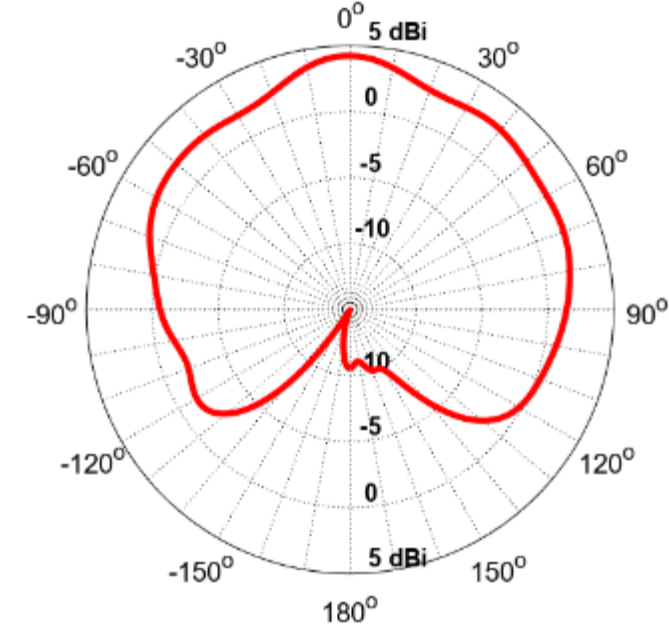
1575 MHz



Elevation
(Front to Back) Cut

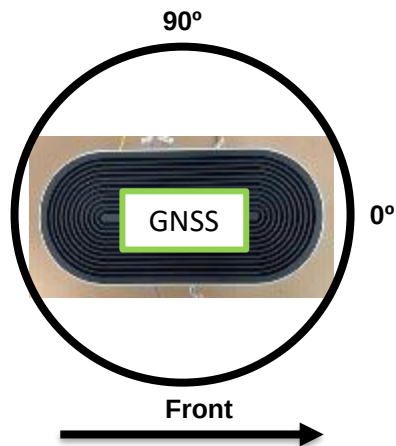


GNSS
EL2 (Side-to-Side) Cut @ Phi=90°
E_{TOTAL} Component

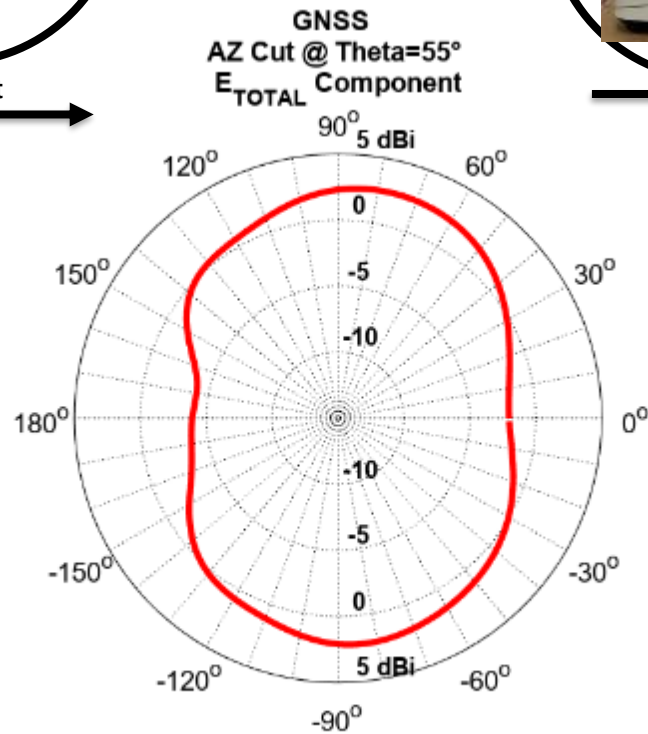


Elevation
(Side to Side) Cut

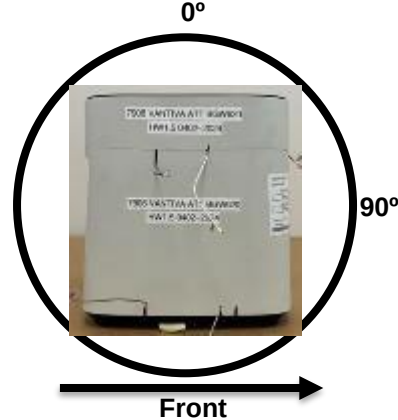
GNSS Antenna Power Sum Gain Patterns



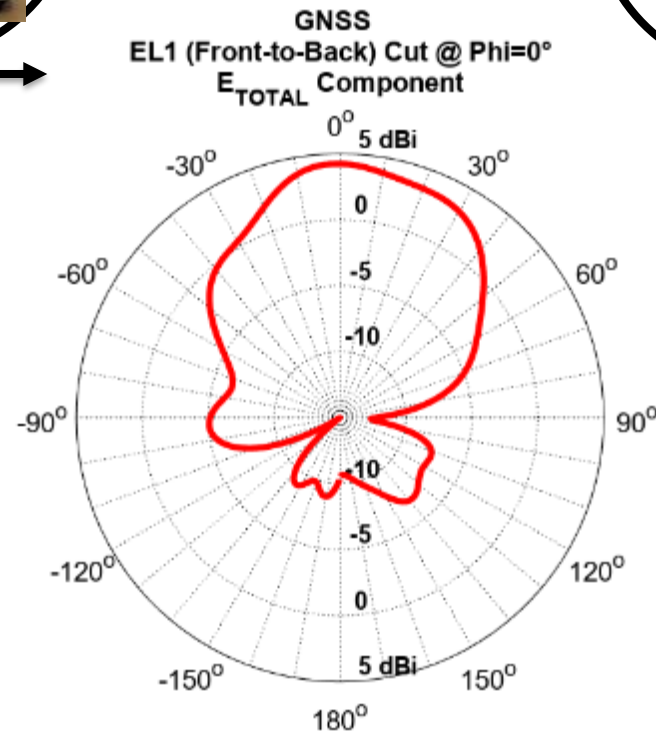
1575 MHz



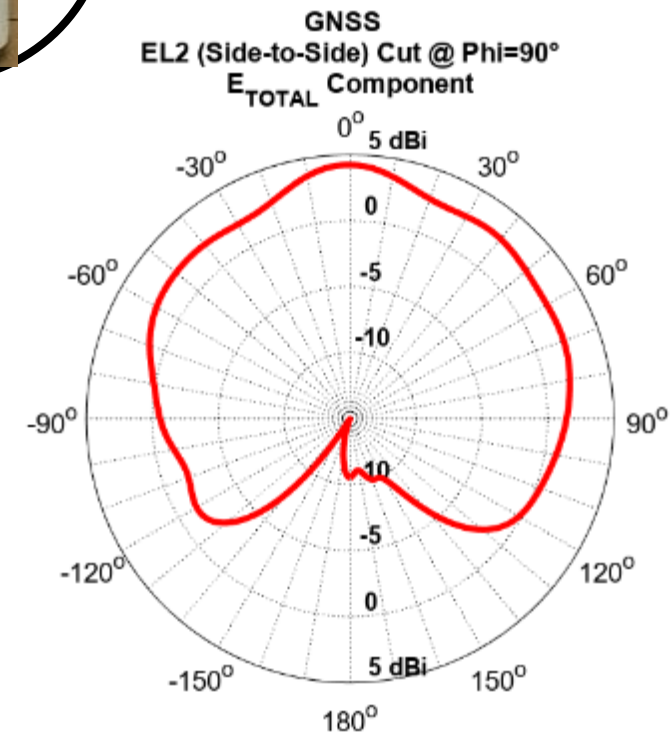
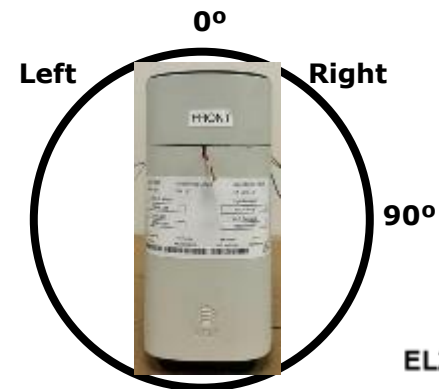
Azimuth Cut ($\theta = 35^\circ$)
GPS inclination angle is 55°



1575 MHz

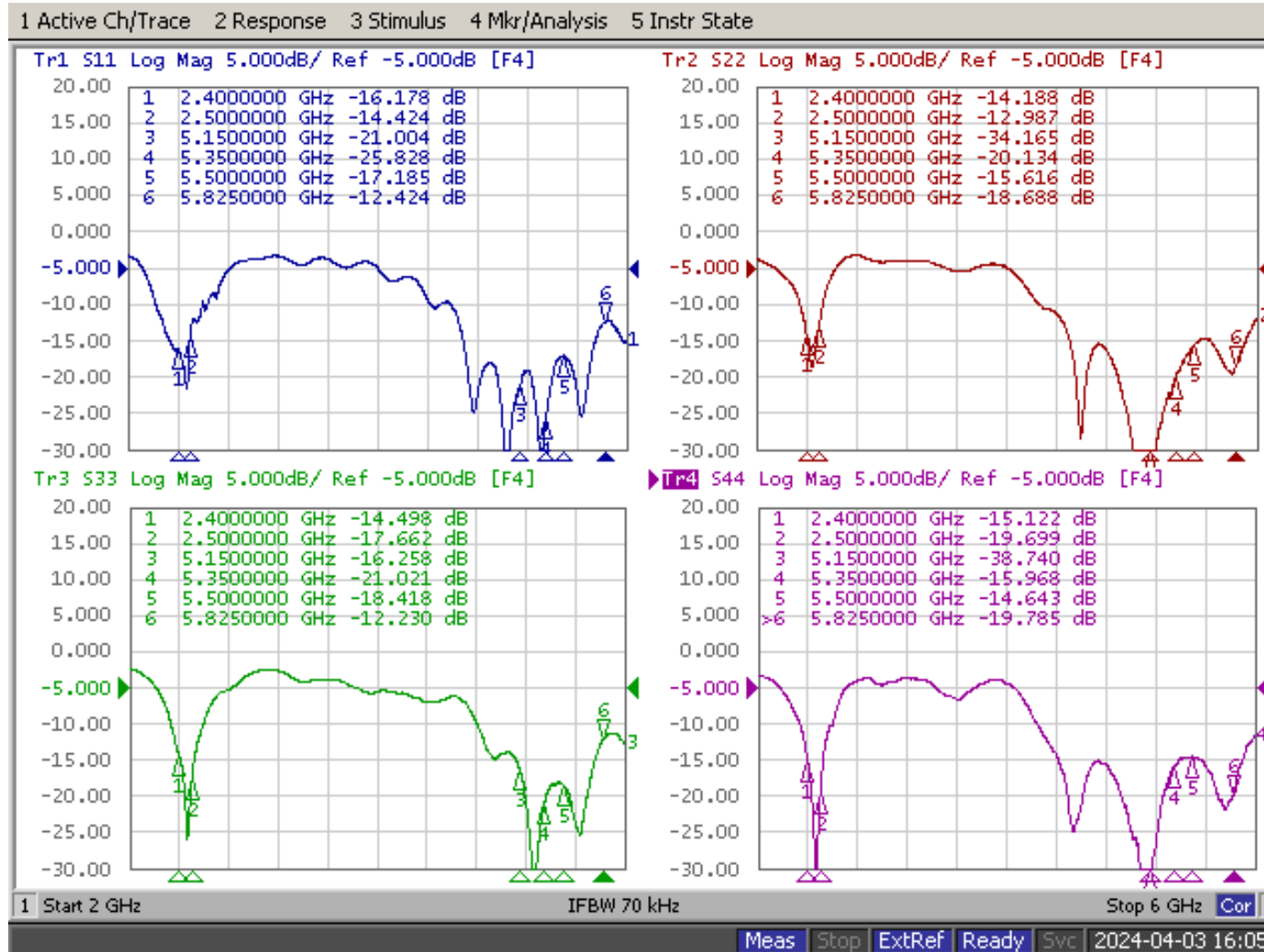


Elevation
(Front to Back) Cut



Elevation
(Side to Side) Cut

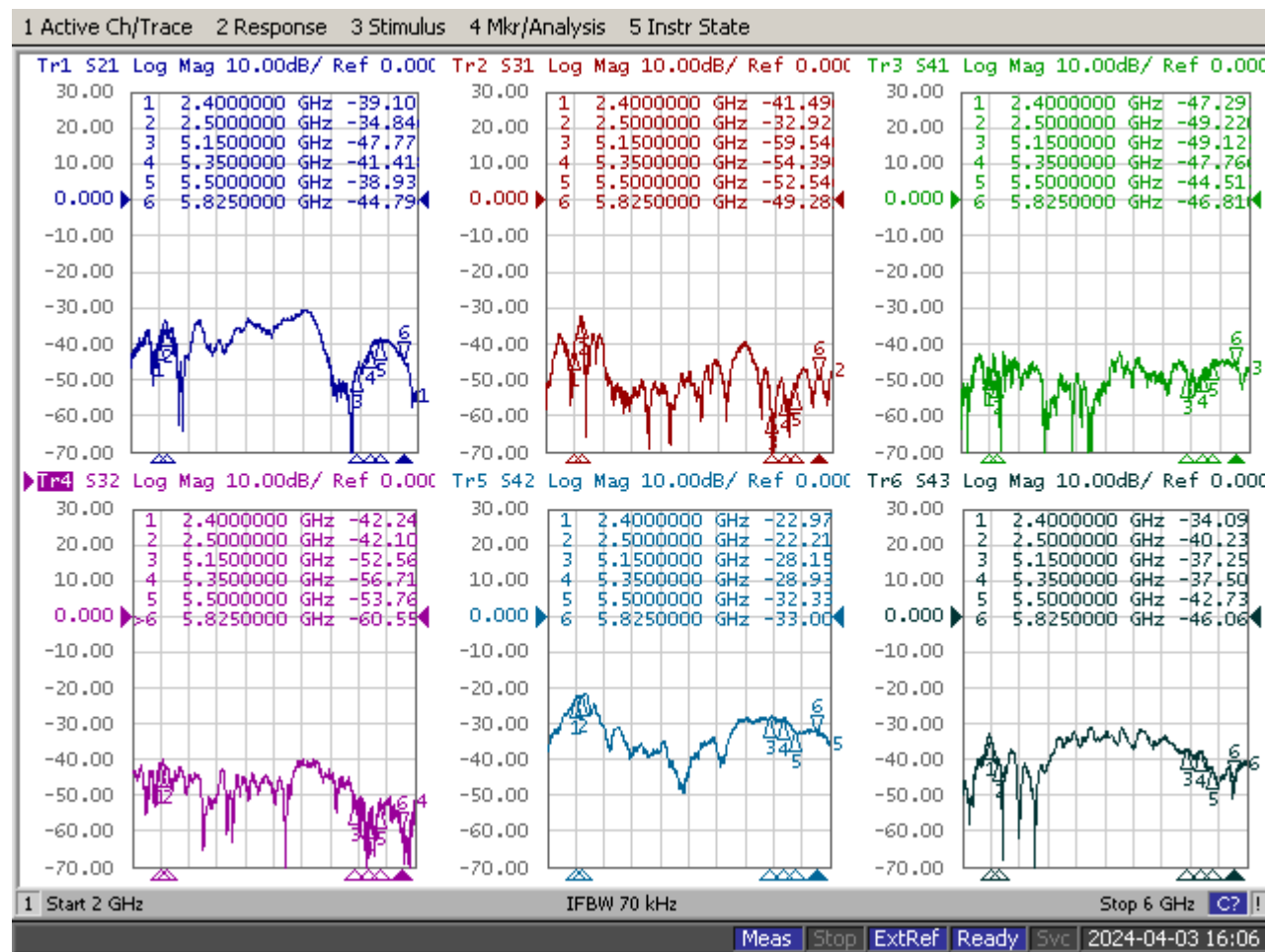
Return Loss of the Dual Band Antennas



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



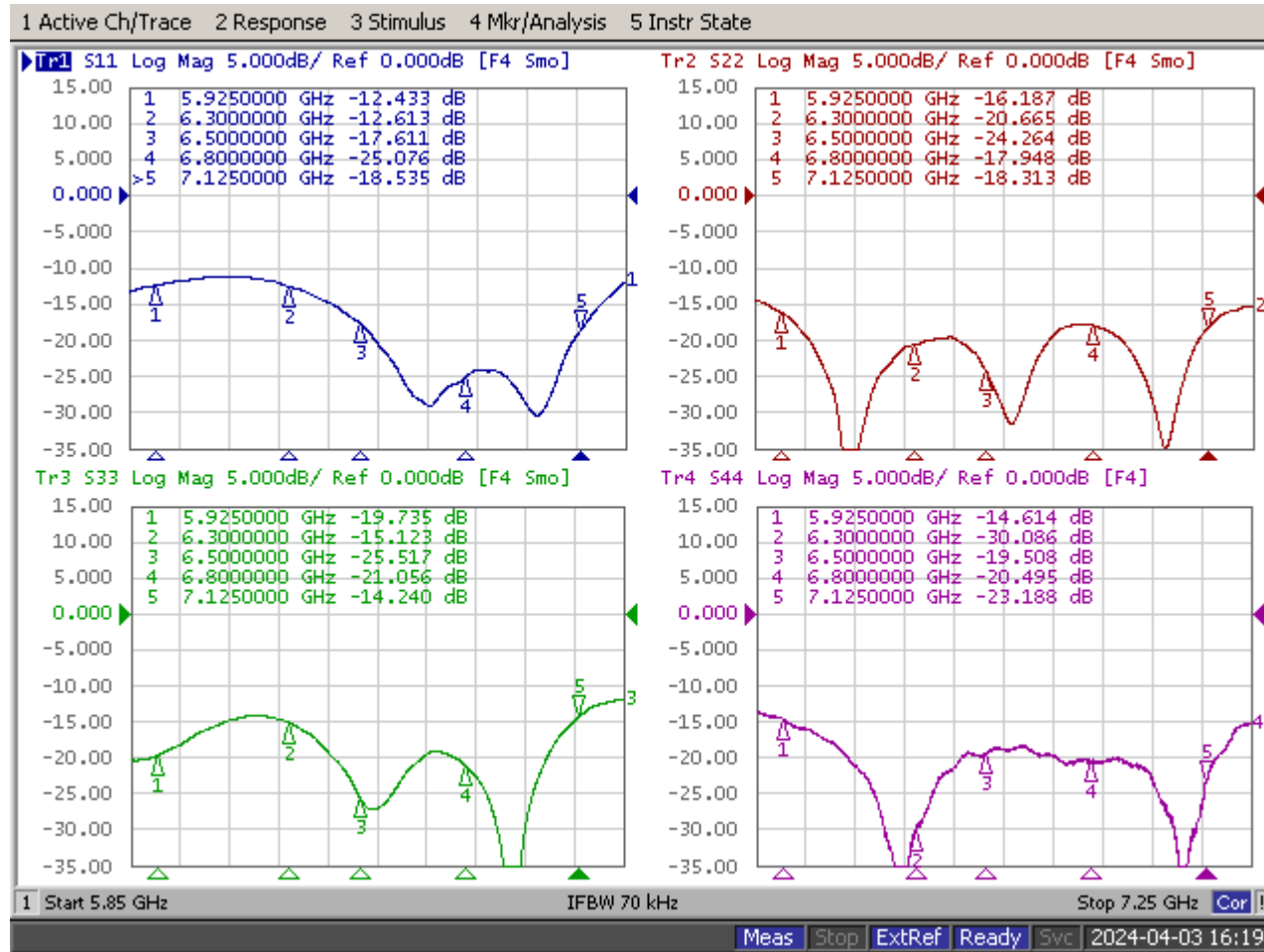
Isolation of the Dual Band Antennas



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



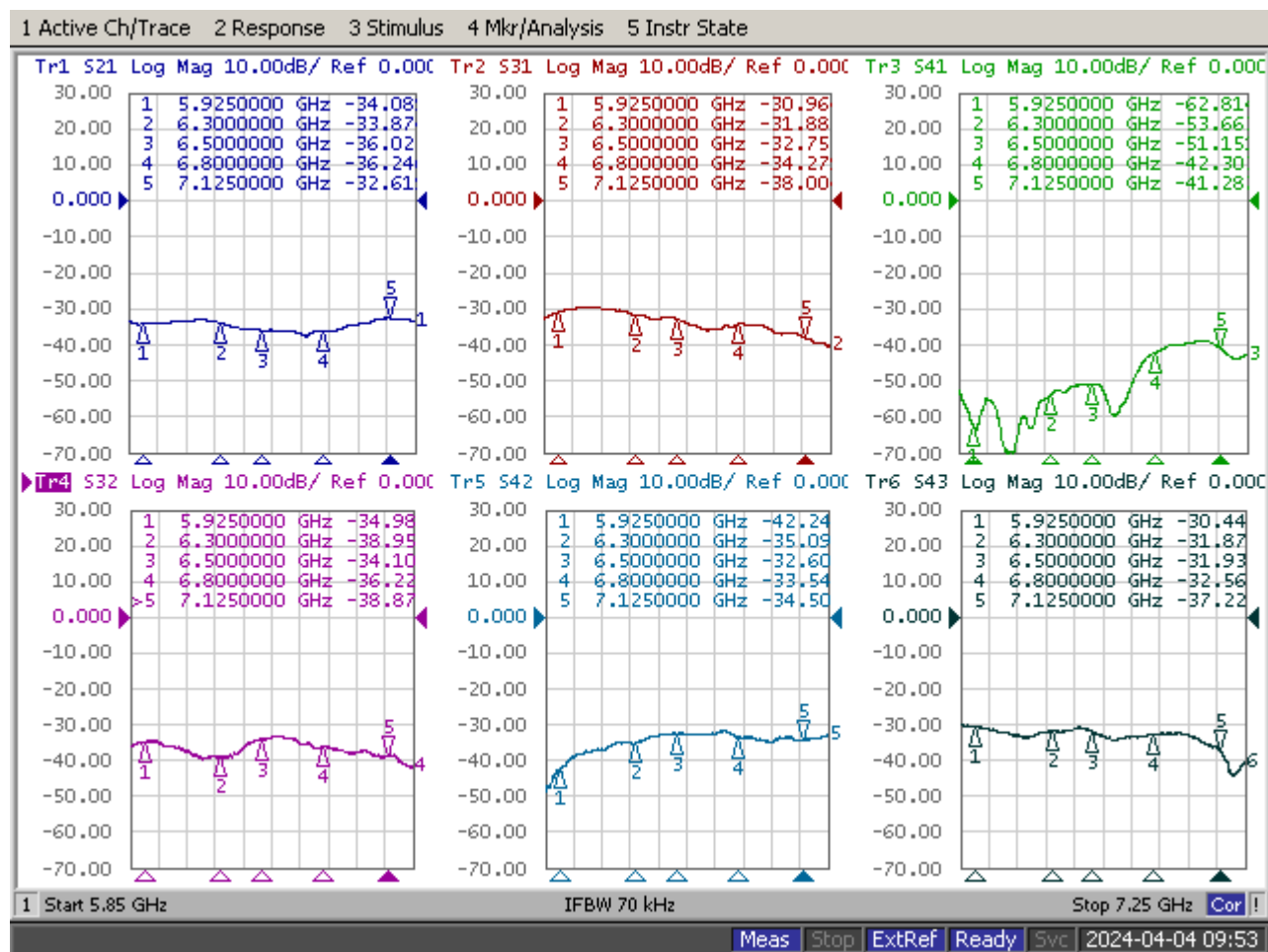
Return Loss of 6 GHz Antennas



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



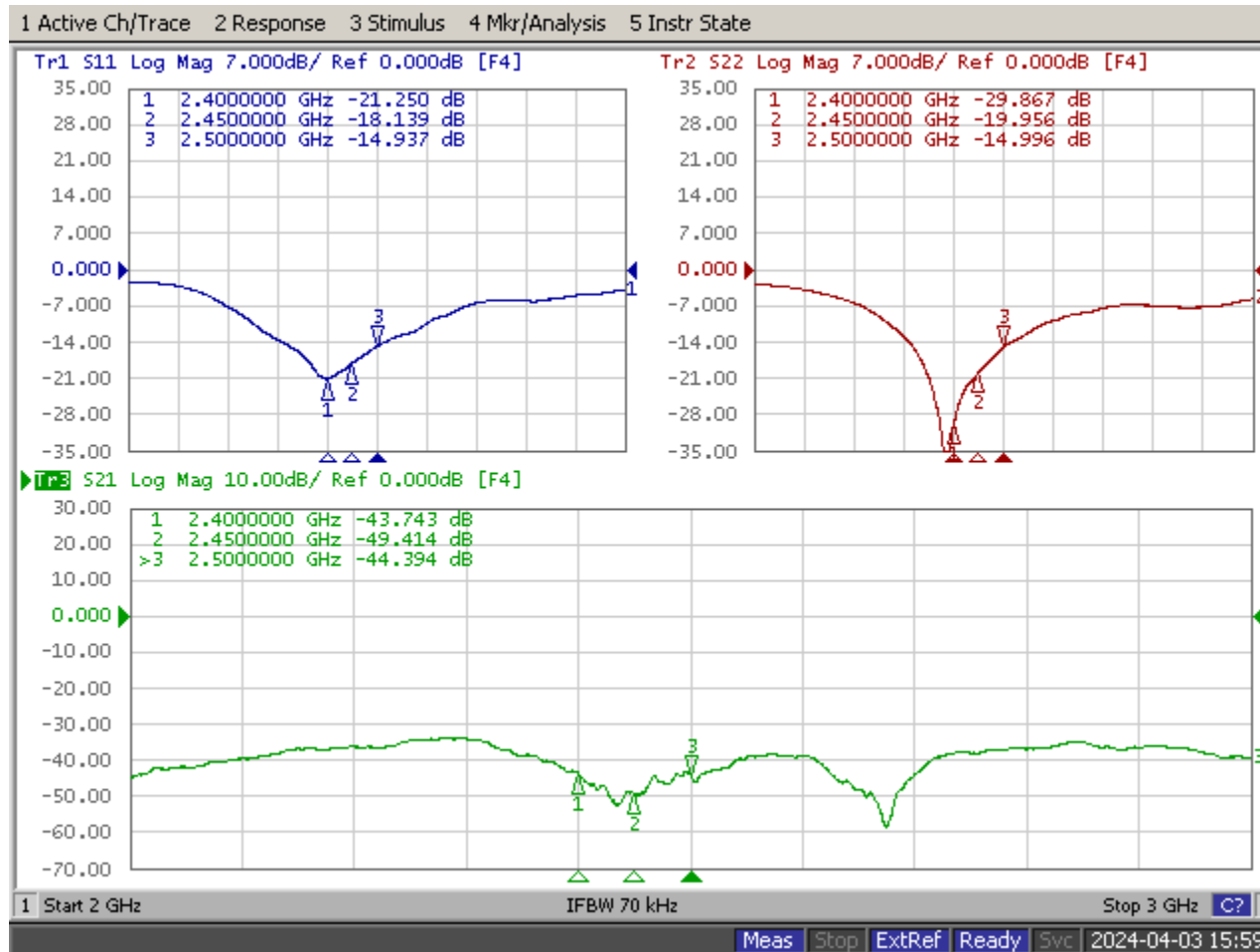
Isolation between 6 GHz Antennas



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



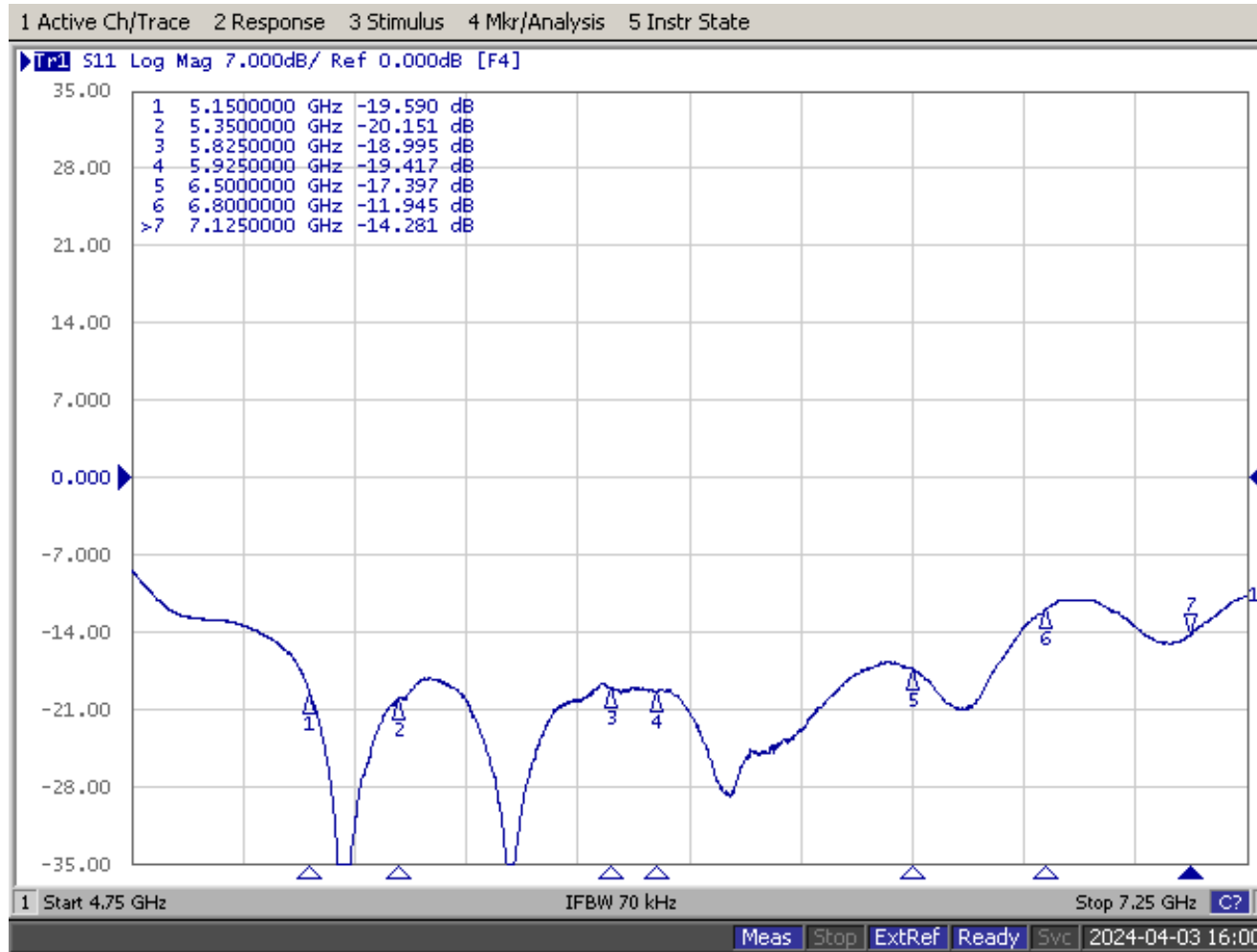
Return Loss and Isolation of IoT antennas



Port 1 = IoT1 Port 2 = IoT2

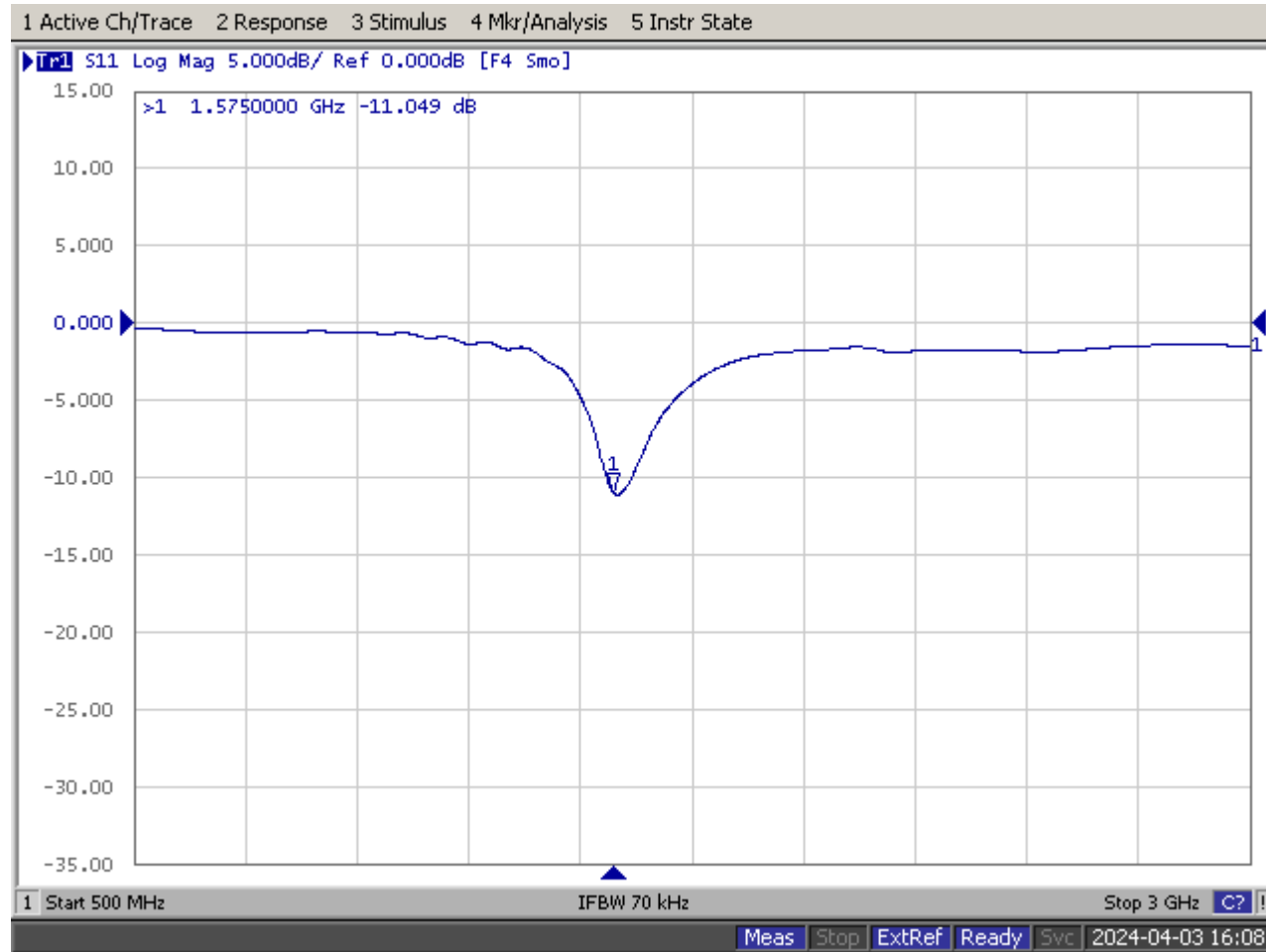


Return Loss of the DFS Antenna

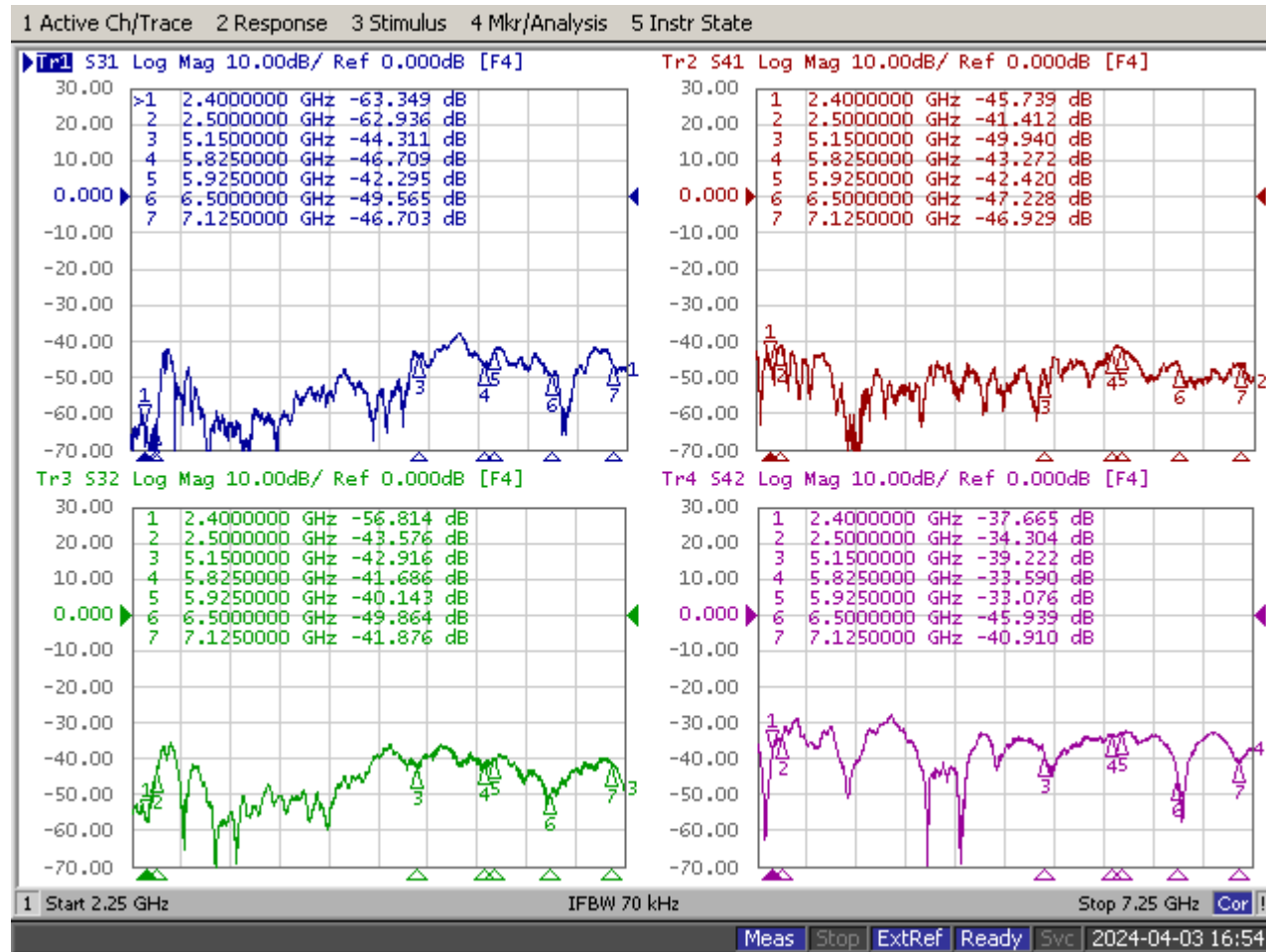


DFS

Return Loss of the GNSS Antenna



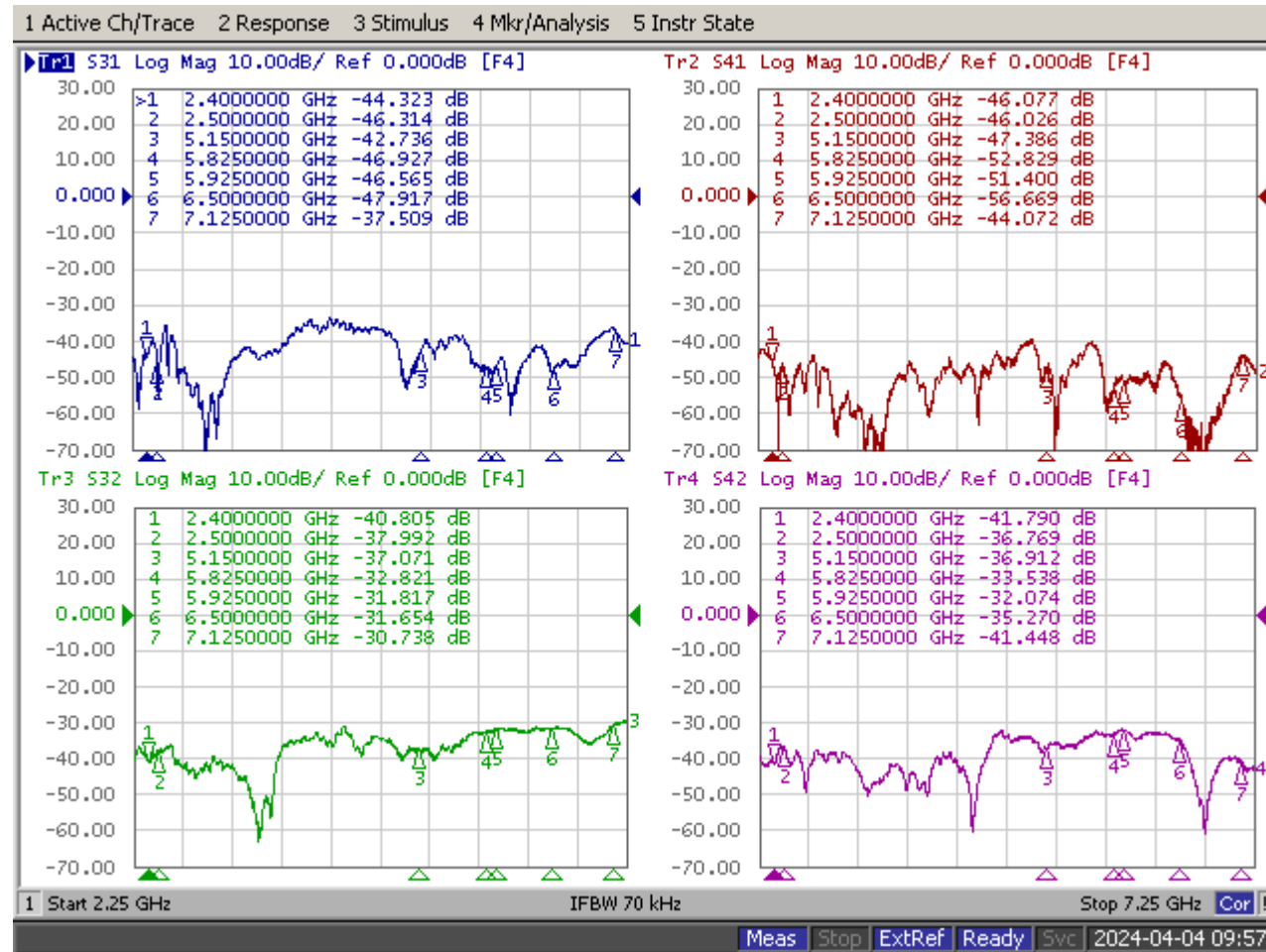
Isolation between DB and 6 GHz Antennas



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



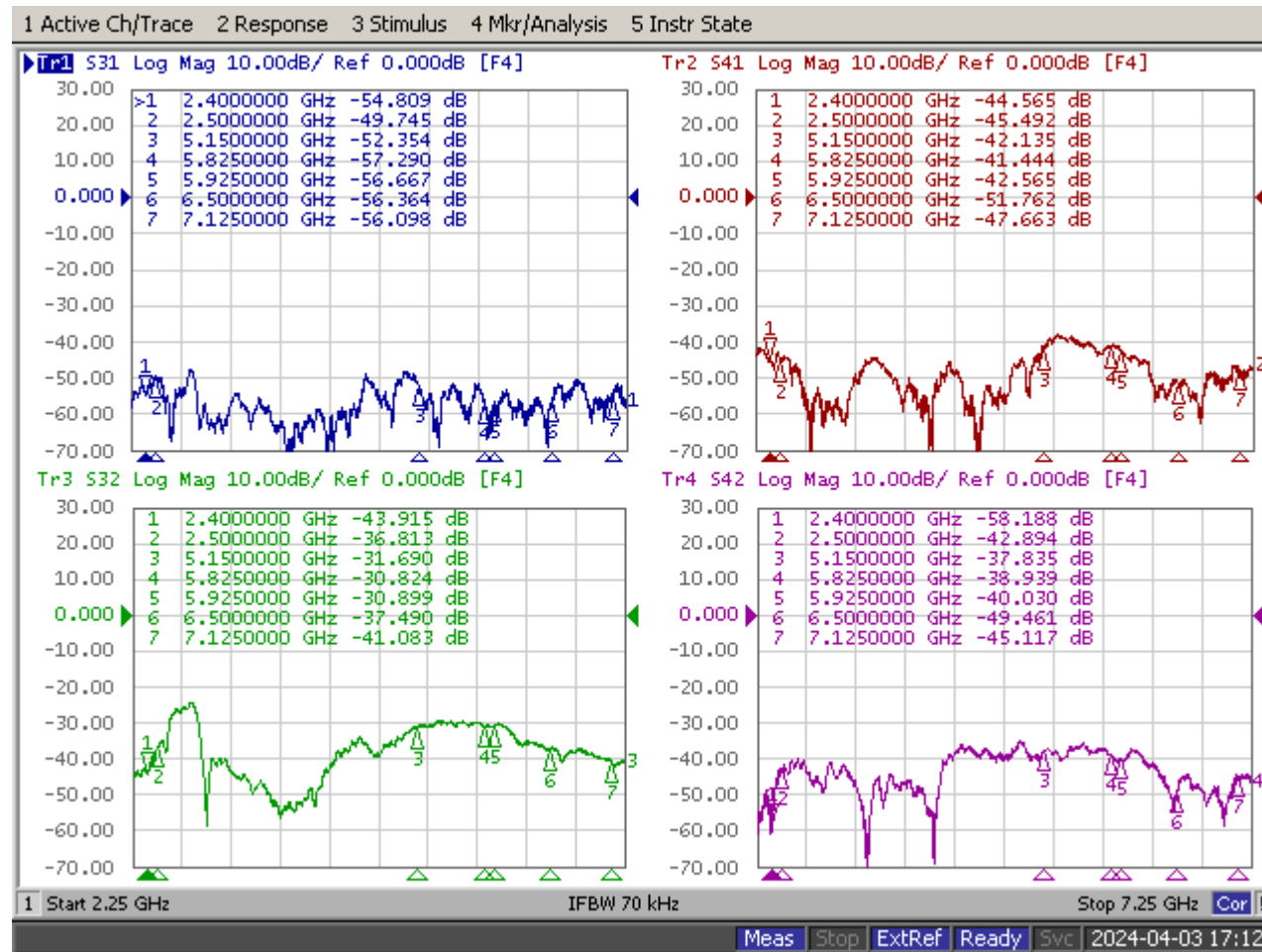
Isolation between DB and 6 GHz Antennas



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



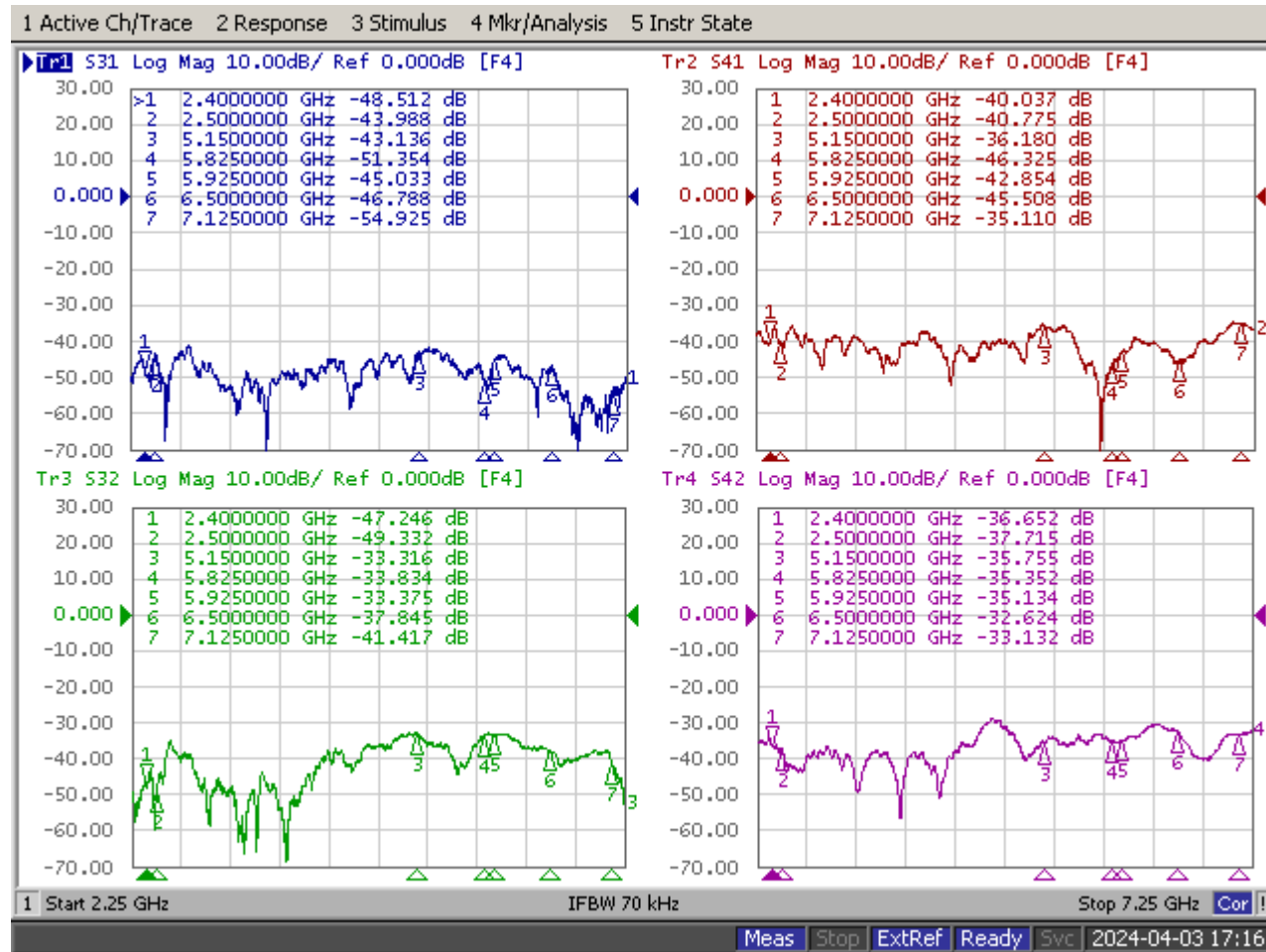
Isolation between DB and 6 GHz Antennas



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



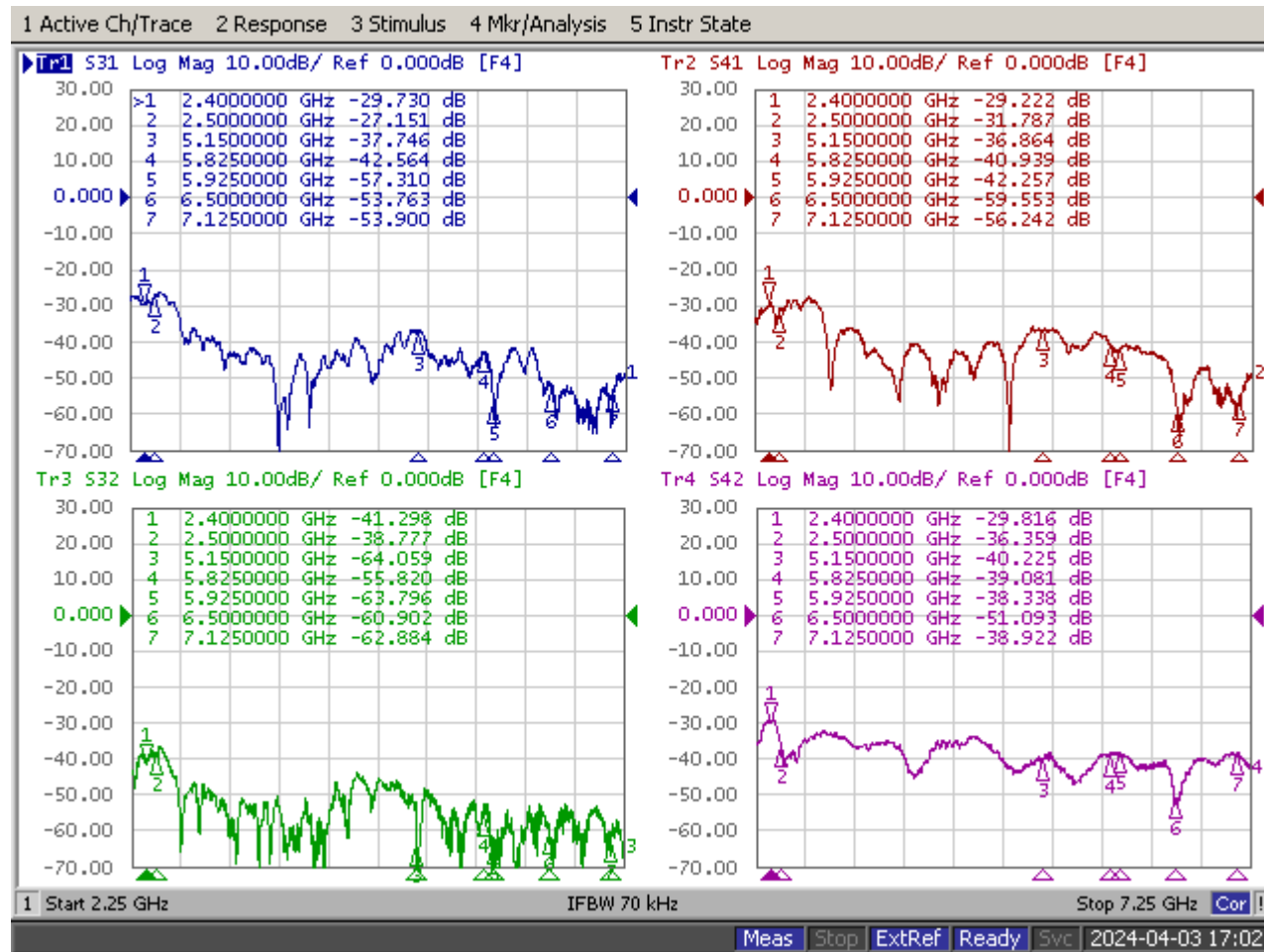
Isolation between DB and 6 GHz Antennas



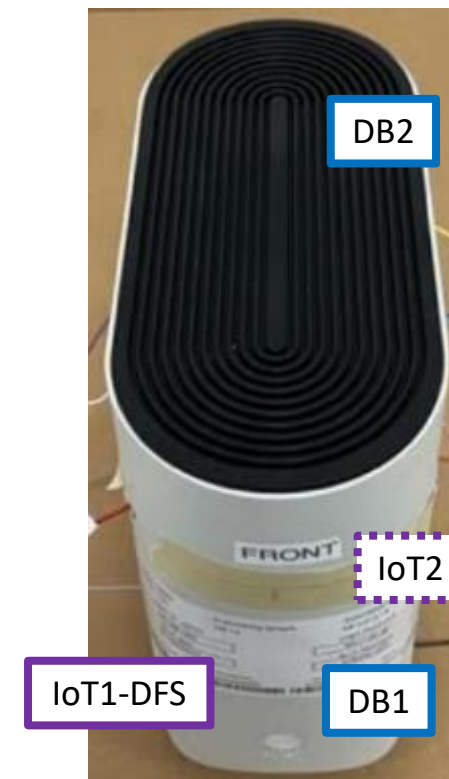
Port 1= DB3	Port 2= DB4
Port 3= 6G3	Port 4= 6G4



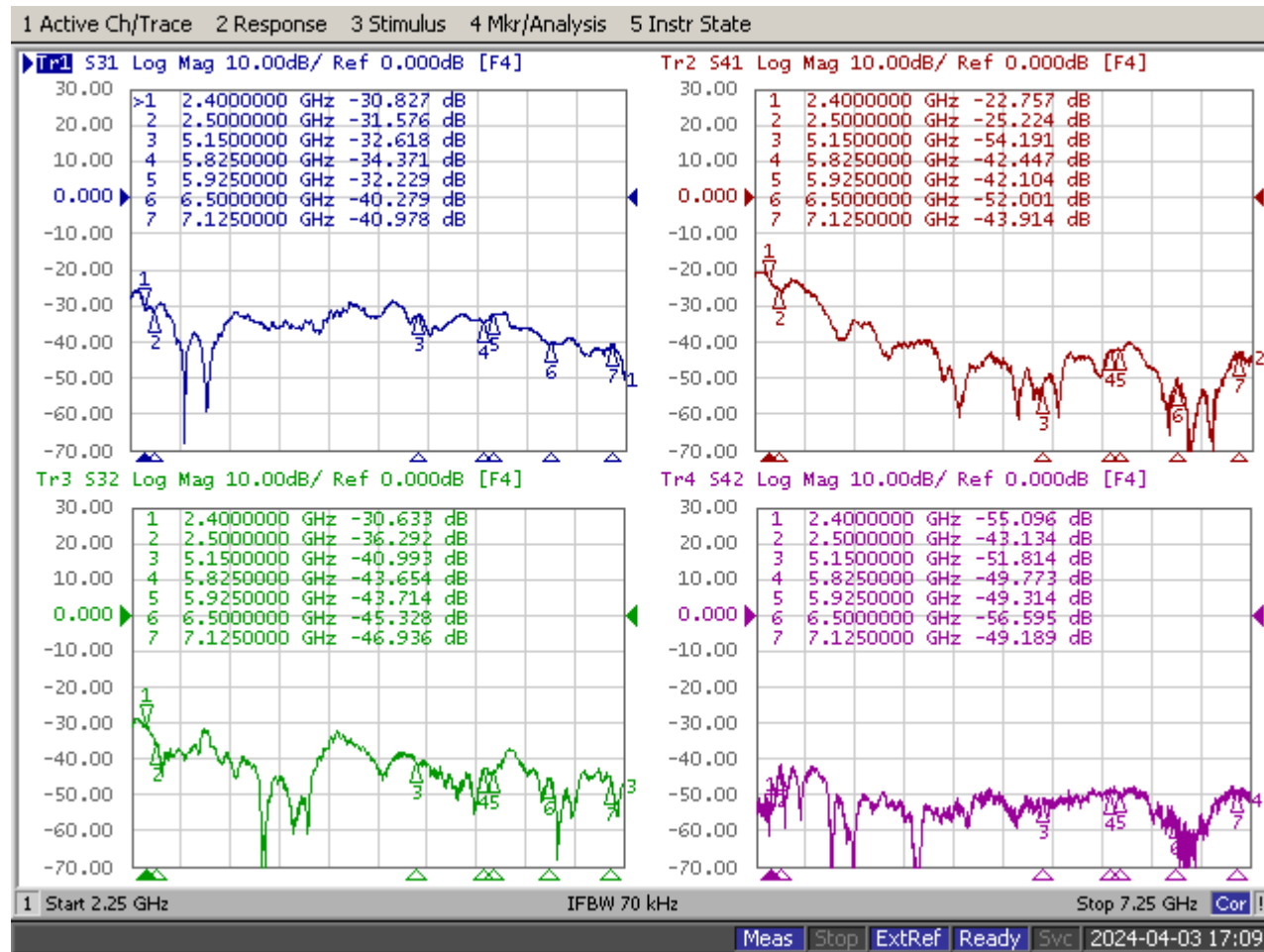
Isolation between DB, IoT and DFS Antennas



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



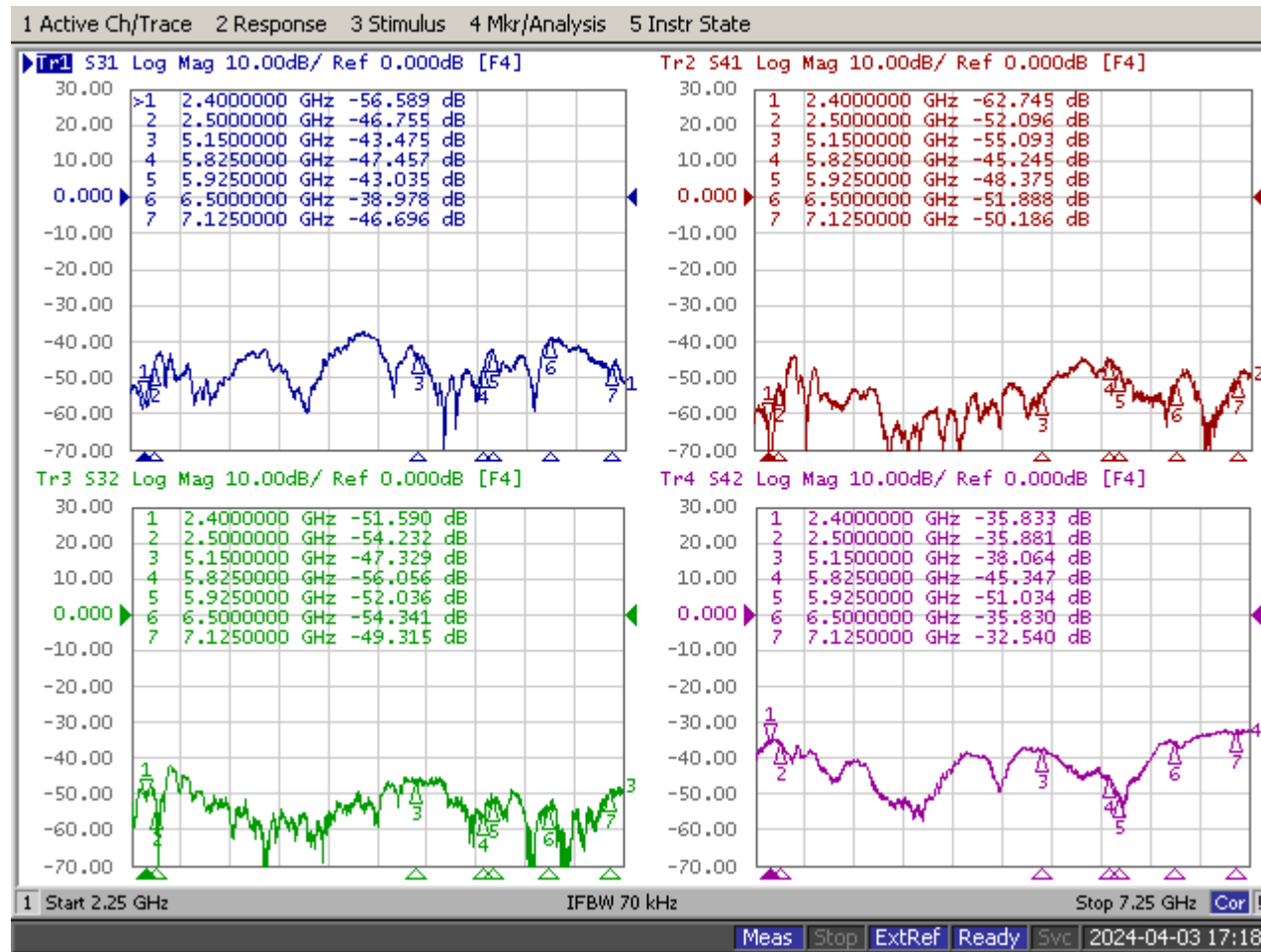
Isolation between DB, IoT and DFS Antennas



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



Isolation between 6 GHz, IoT and DFS Antennas



Port 1= 6G1

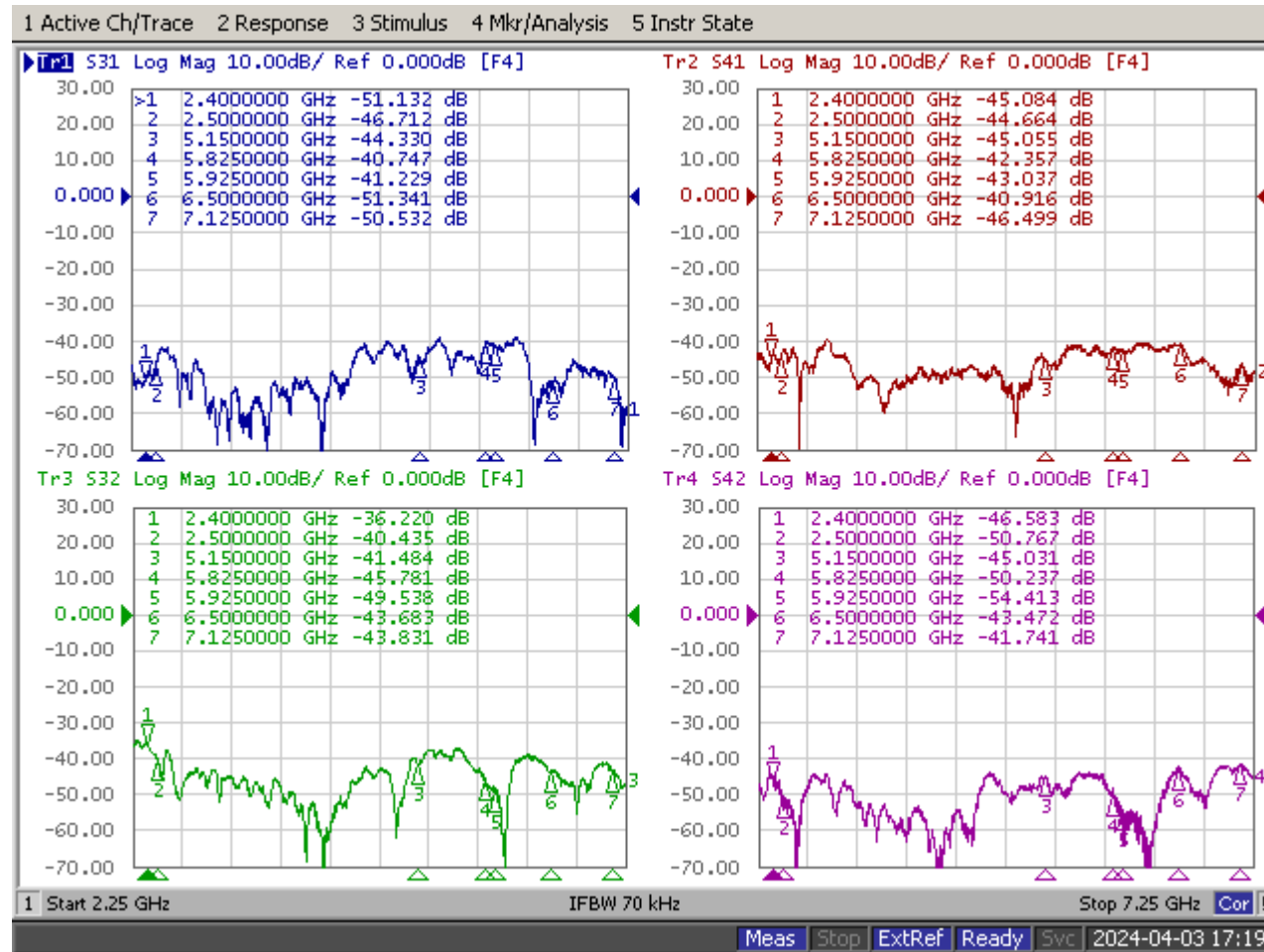
Port 2= 6G2

Port 3= IoT1-DFS

Port 4= IoT2



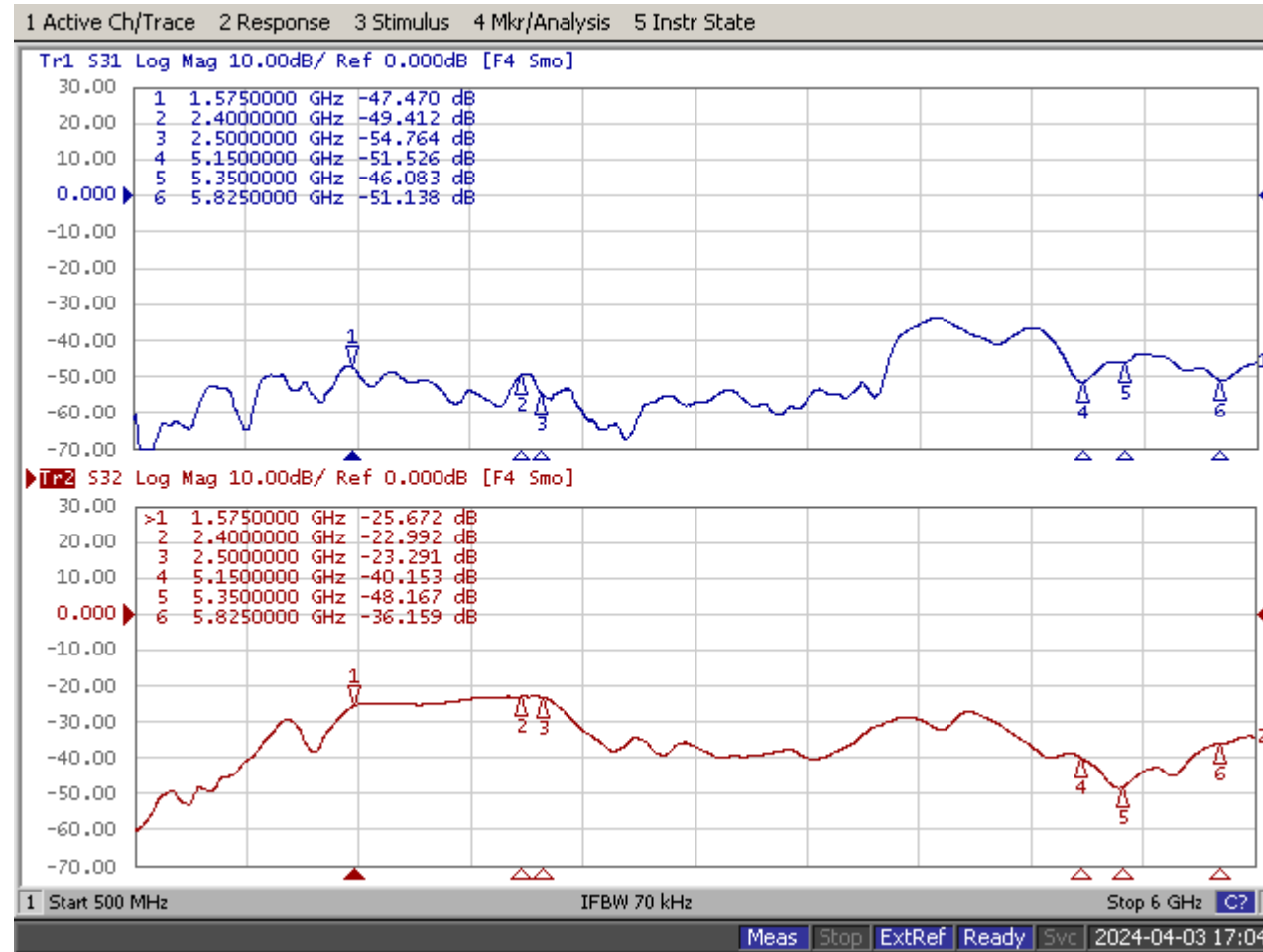
Isolation between 6 GHz, IoT and DFS Antennas



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



Isolation between DB and GNSS Antennas



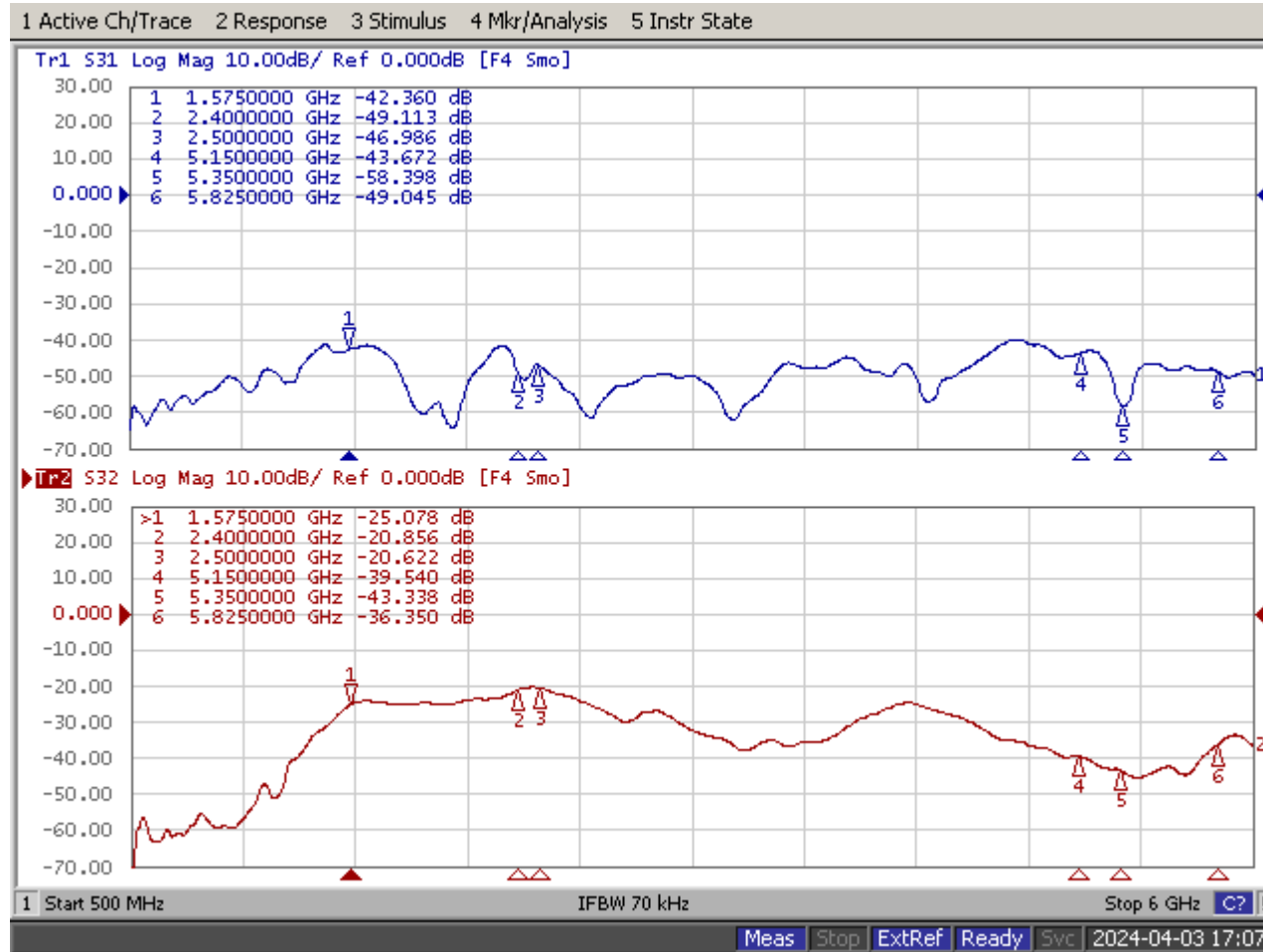
Port 1 = DB1

Port 2 = DB2

Port 3 = GNSS



Isolation between DB and GNSS Antennas

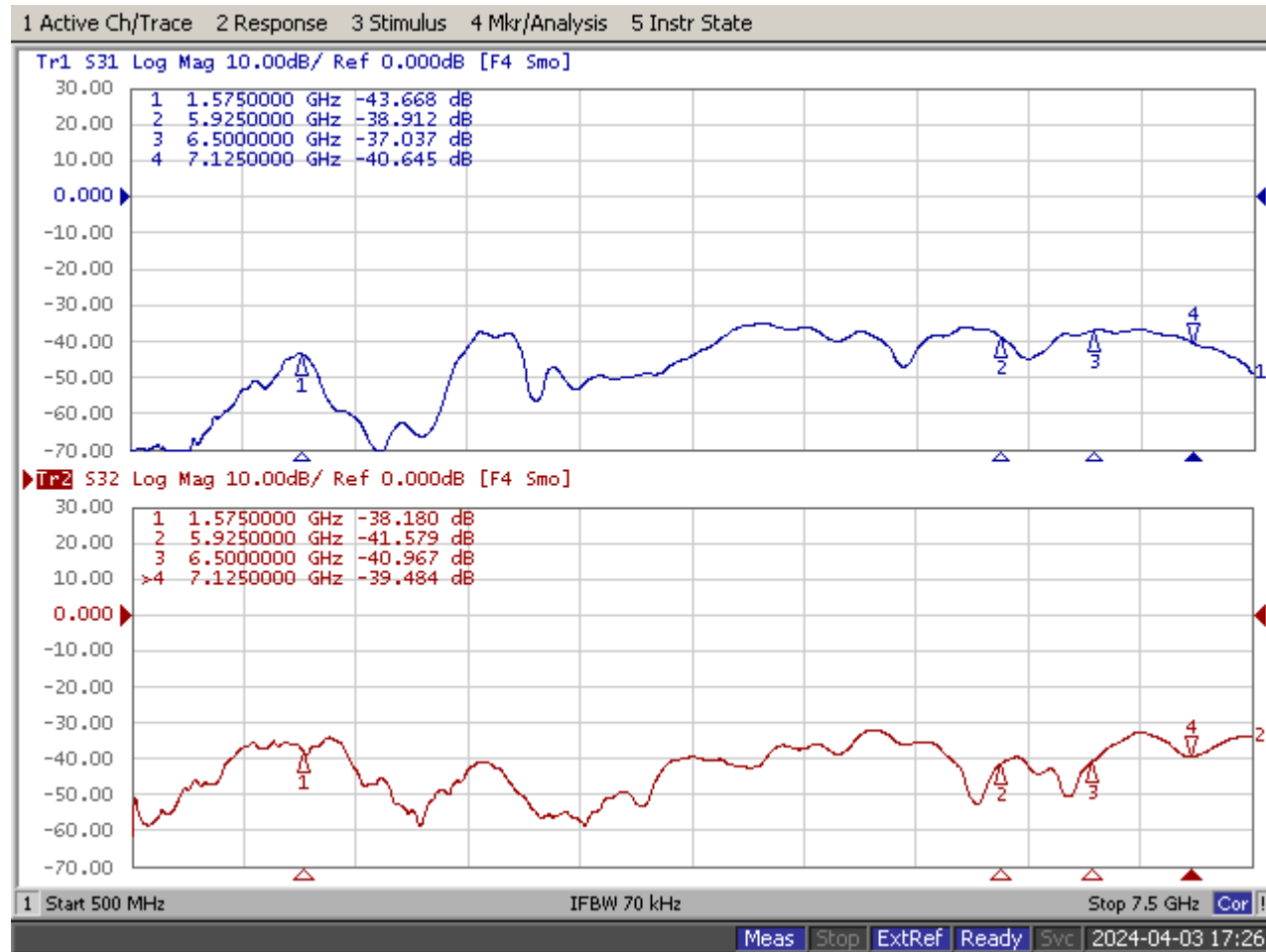


Port 1 = DB3 Port 2 = DB4

Port 3 = GNSS



Isolation between 6 GHz and GNSS Antennas

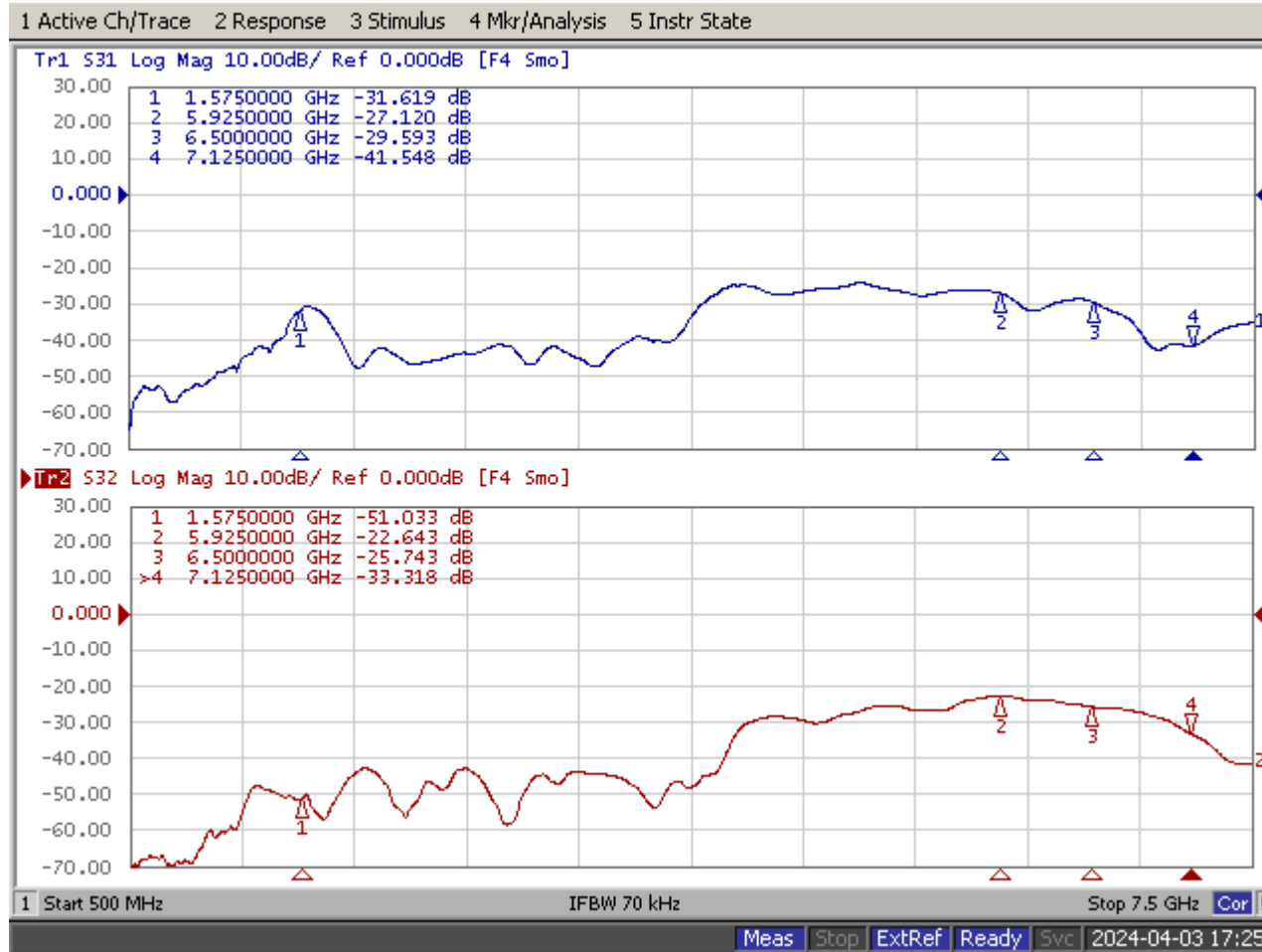


Port 1 = 6G1 Port 2 = 6G2

Port 3 = GNSS



Isolation between 6 GHz and GNSS Antennas

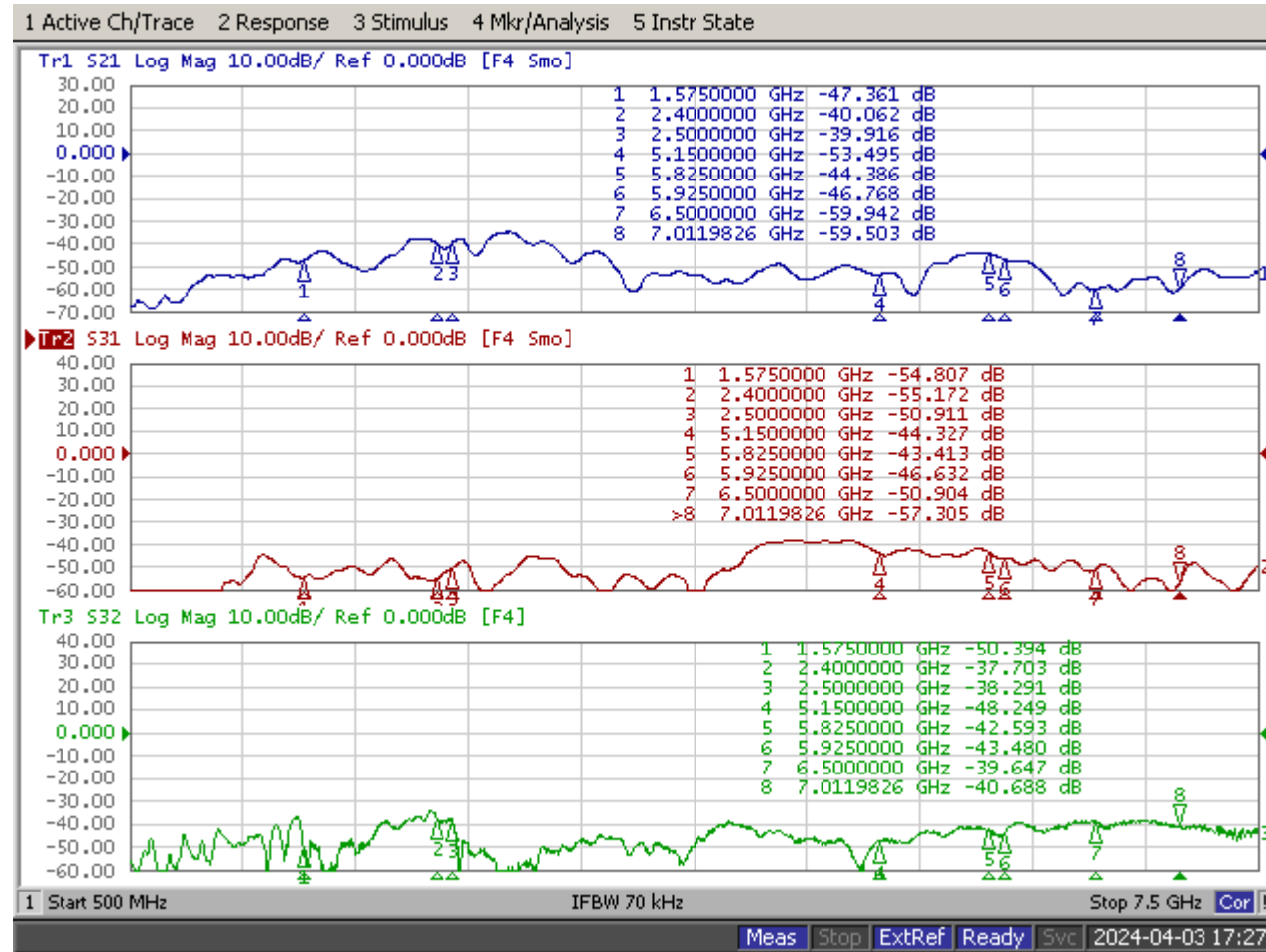


Port 1 = 6G3 Port 2 = 6G4

Port 3 = GNSS



Isolation between IoT, DFS and GNSS Antennas

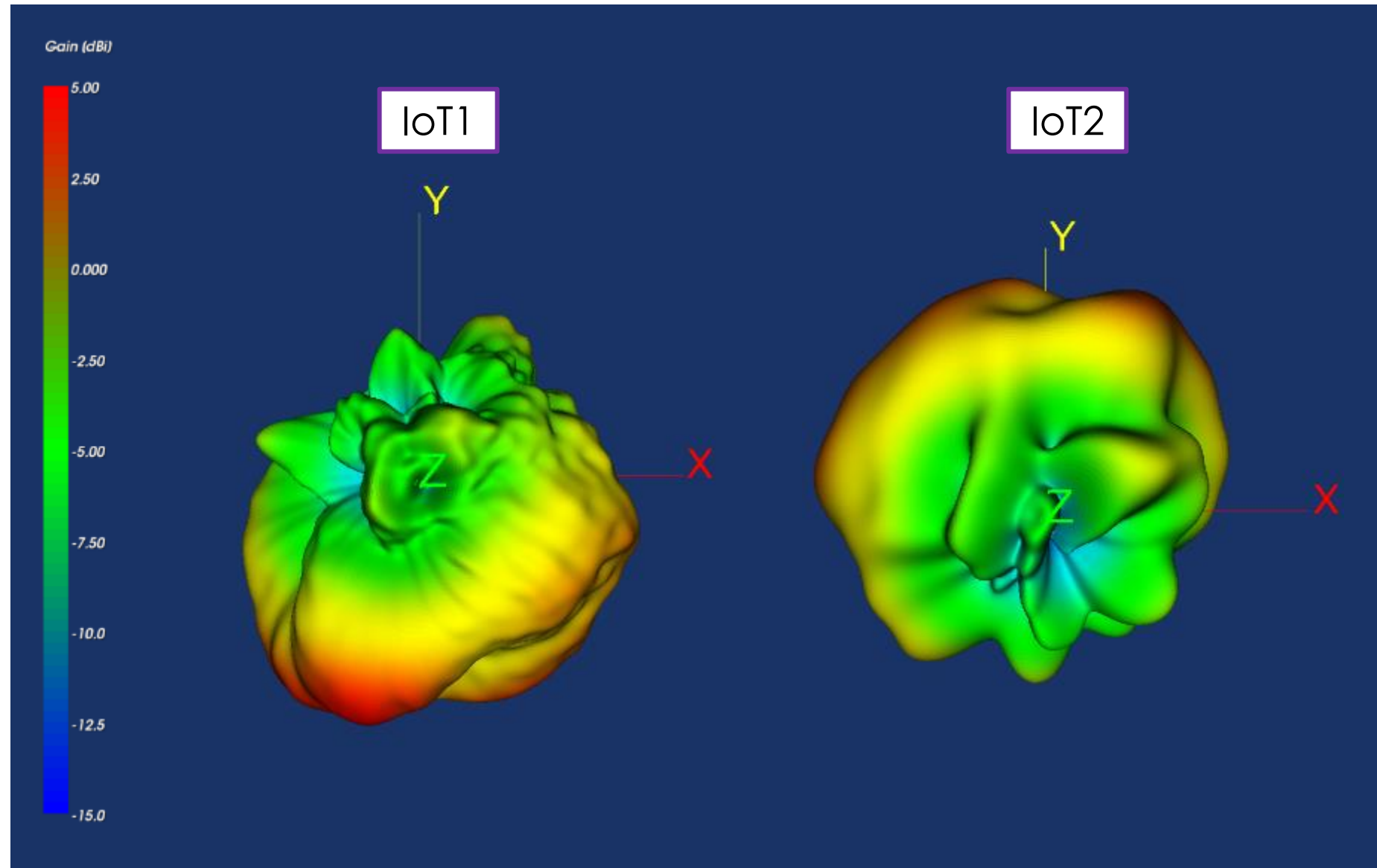
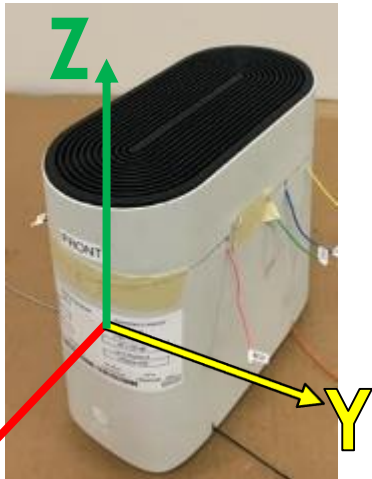
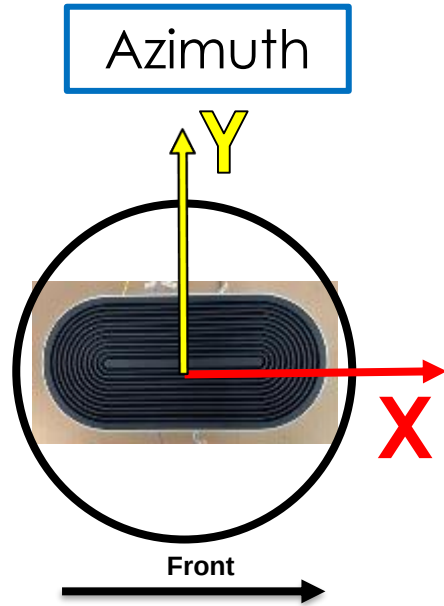


Port 1 = IoT1-DFS Port 2 = IoT2

Port 3 = GNSS

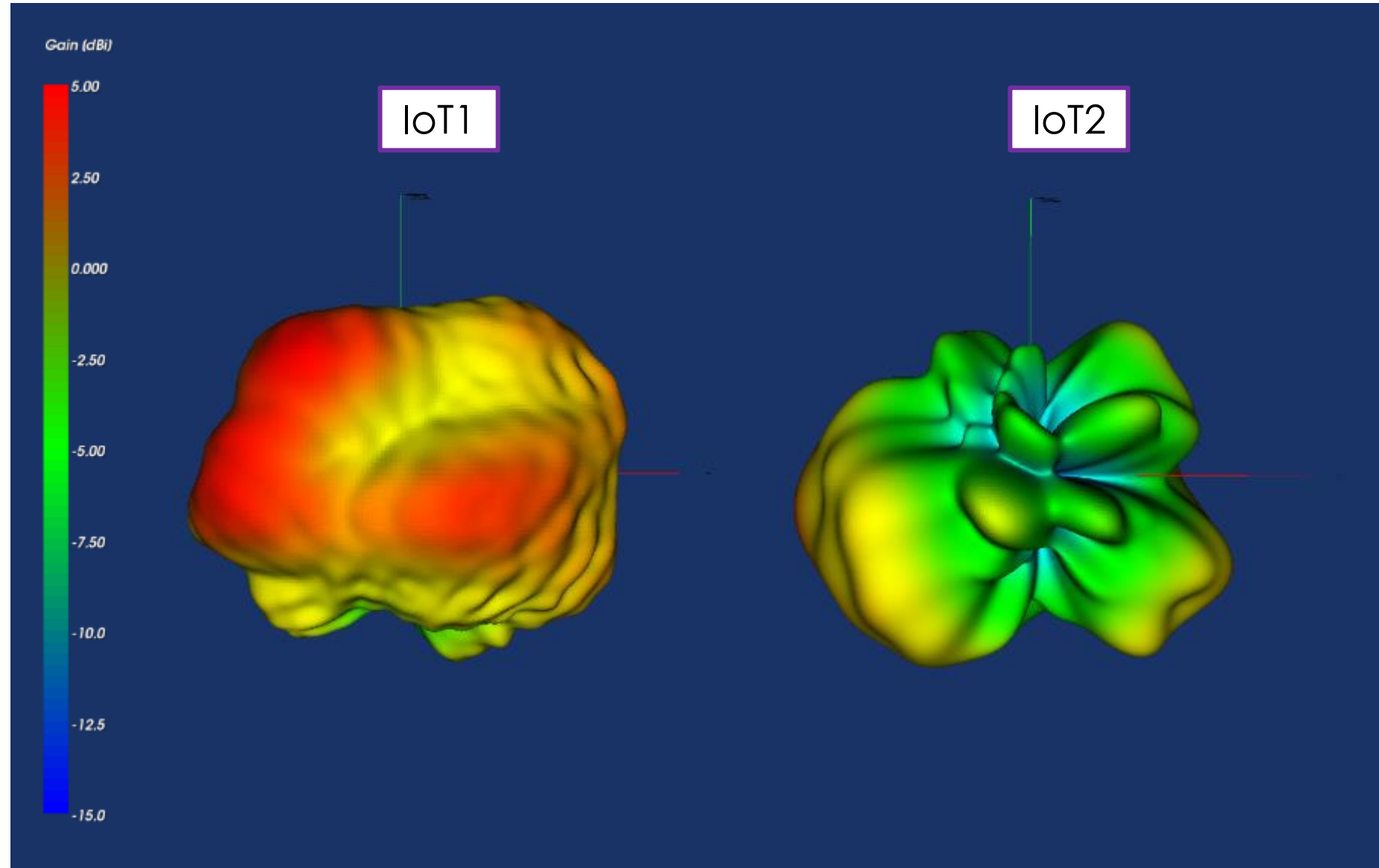
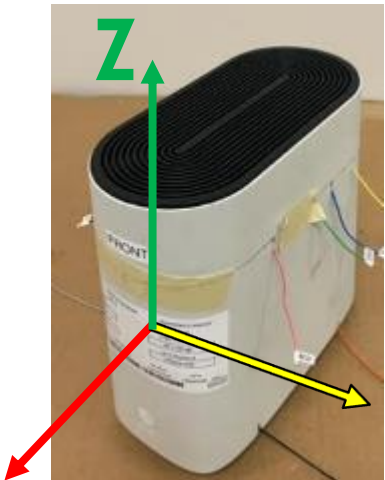
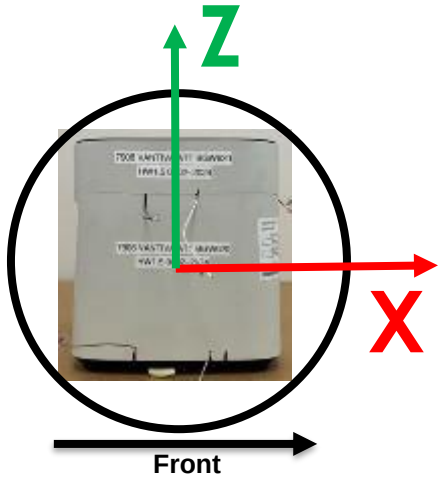


3D Gain Plot – IoT Antennas – 2.45 GHz



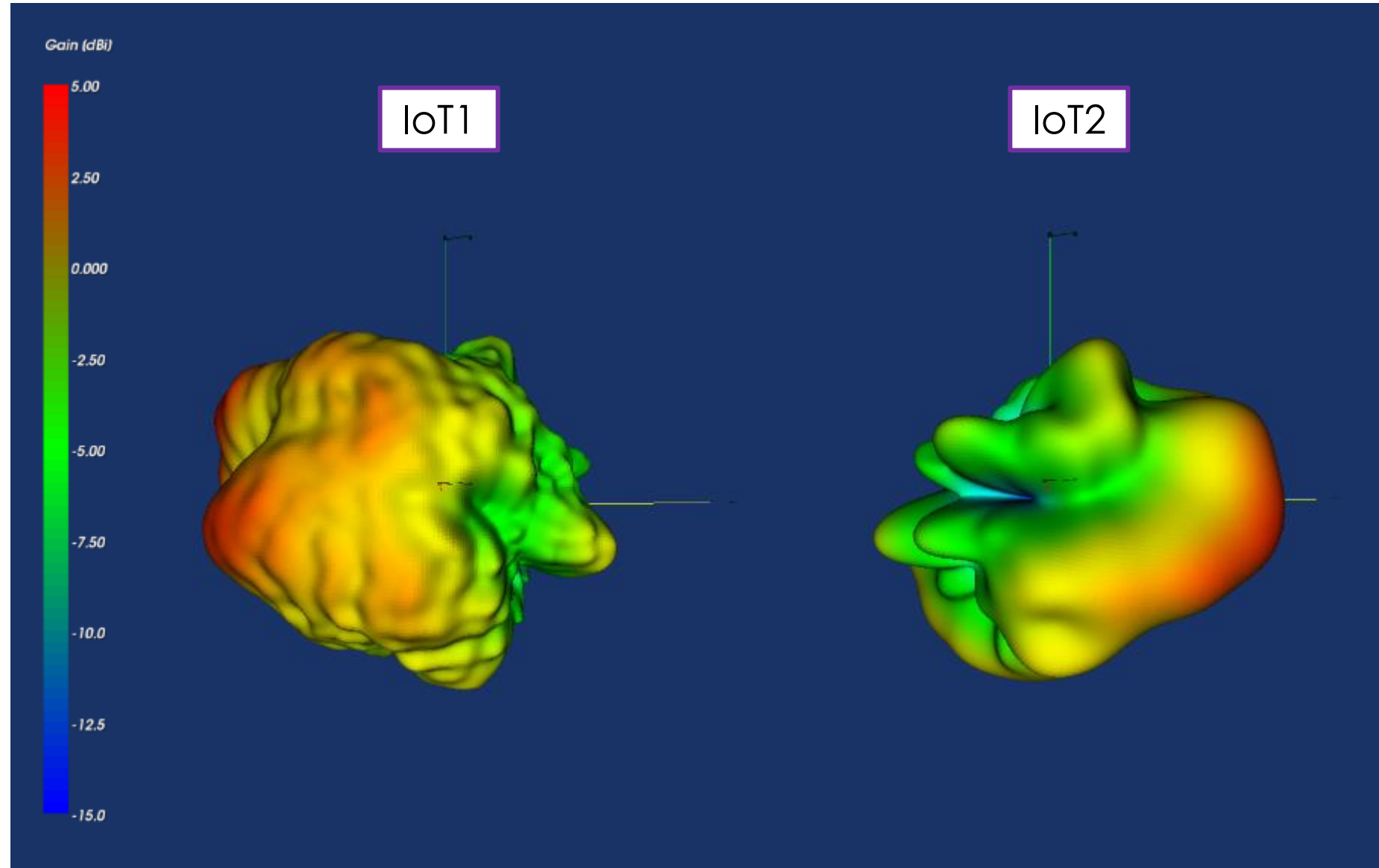
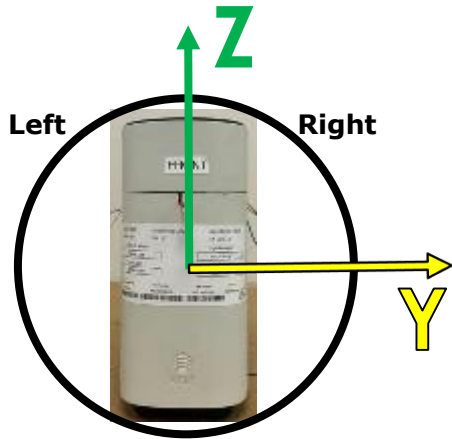
3D Gain Plot – IoT Antennas – 2.45 GHz

Front-to-Back

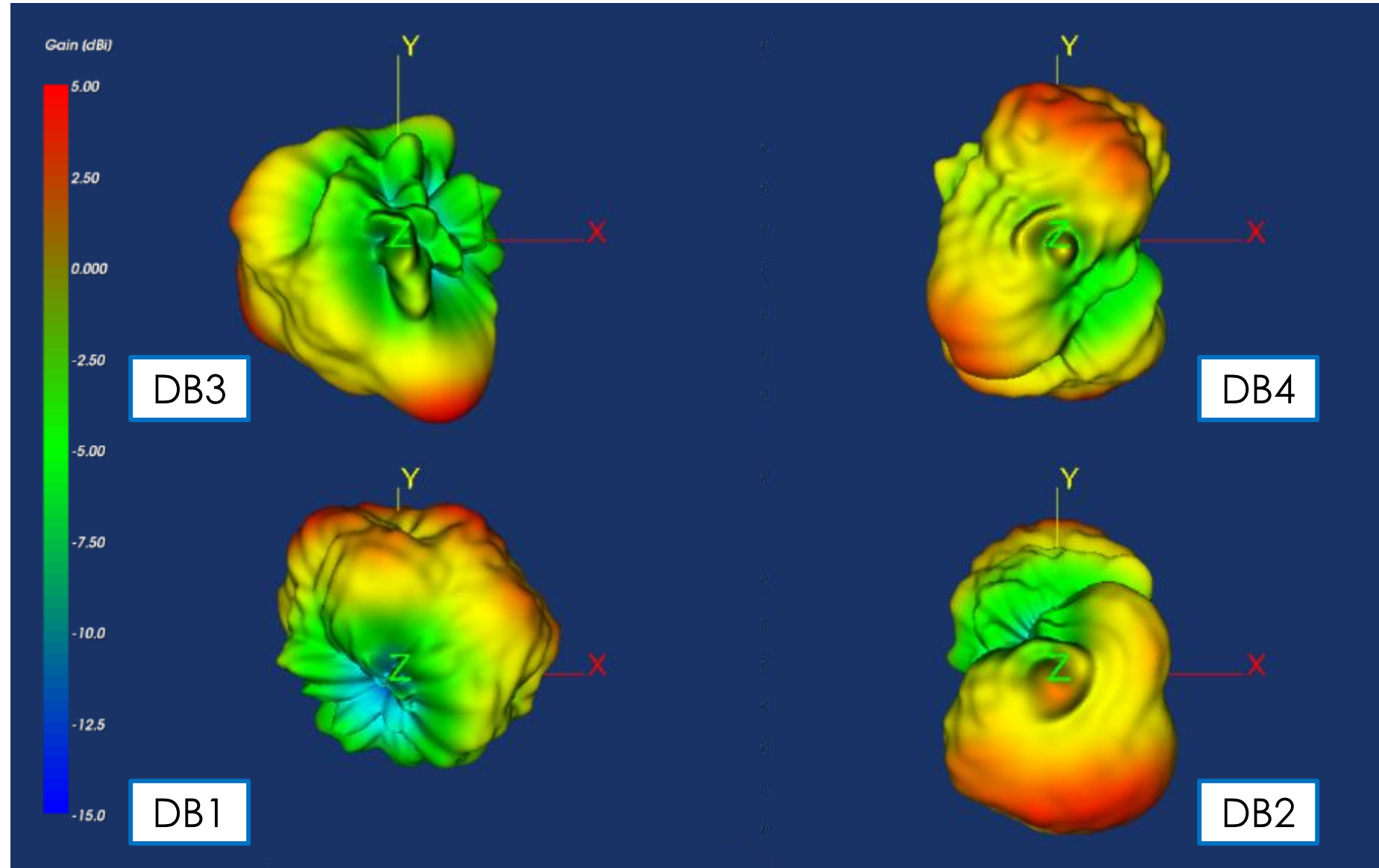
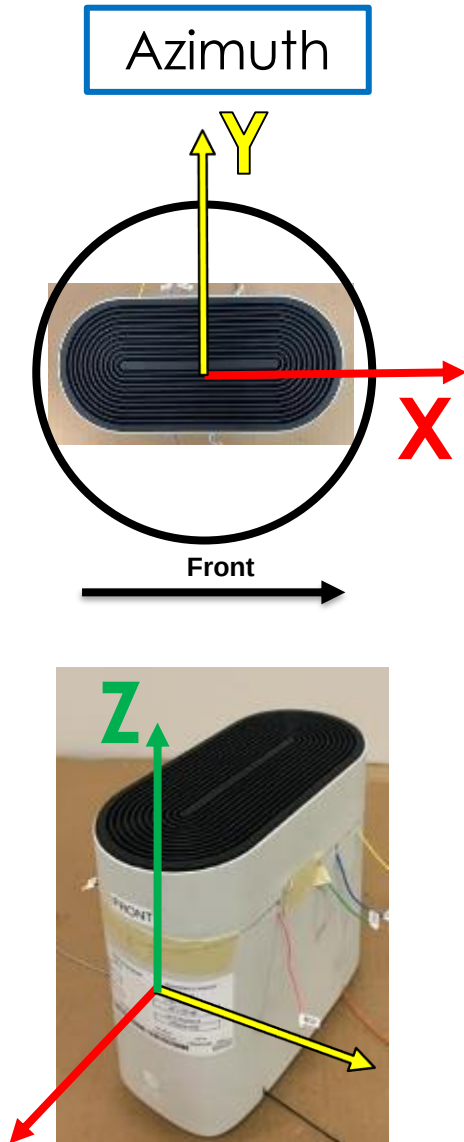


3D Gain Plot – IoT Antennas – 2.45 GHz

Side-to-Side

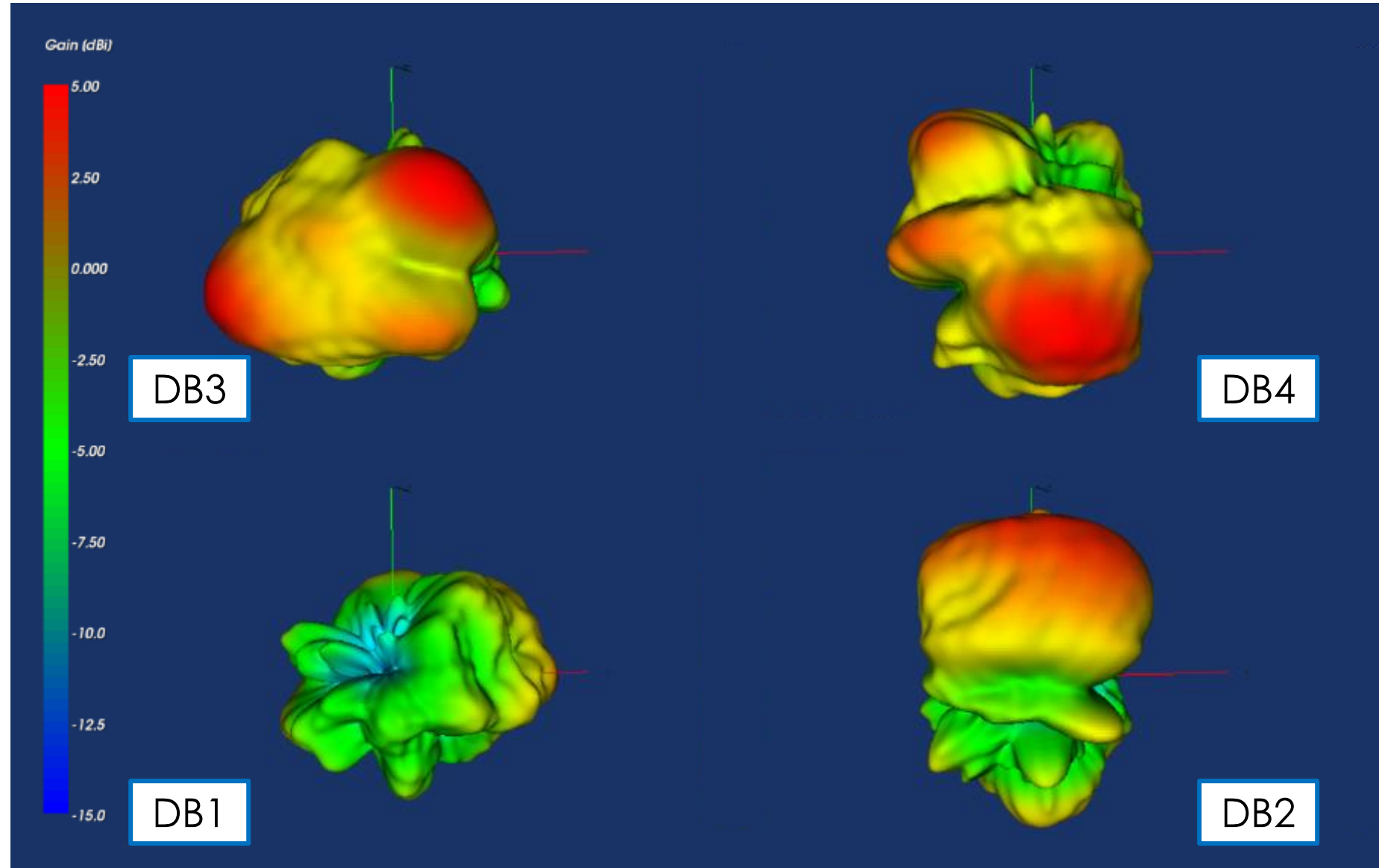
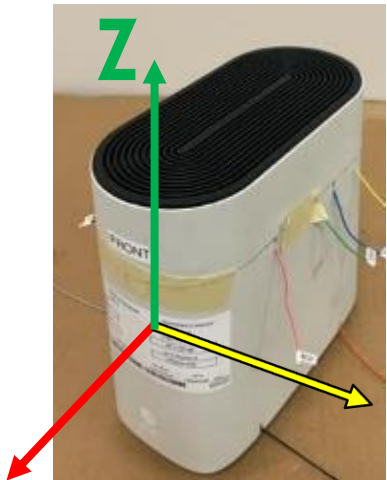
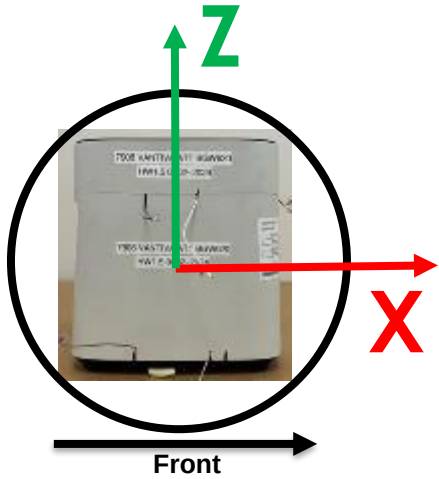


3D Gain Plot – DB Antennas – 2.45 GHz



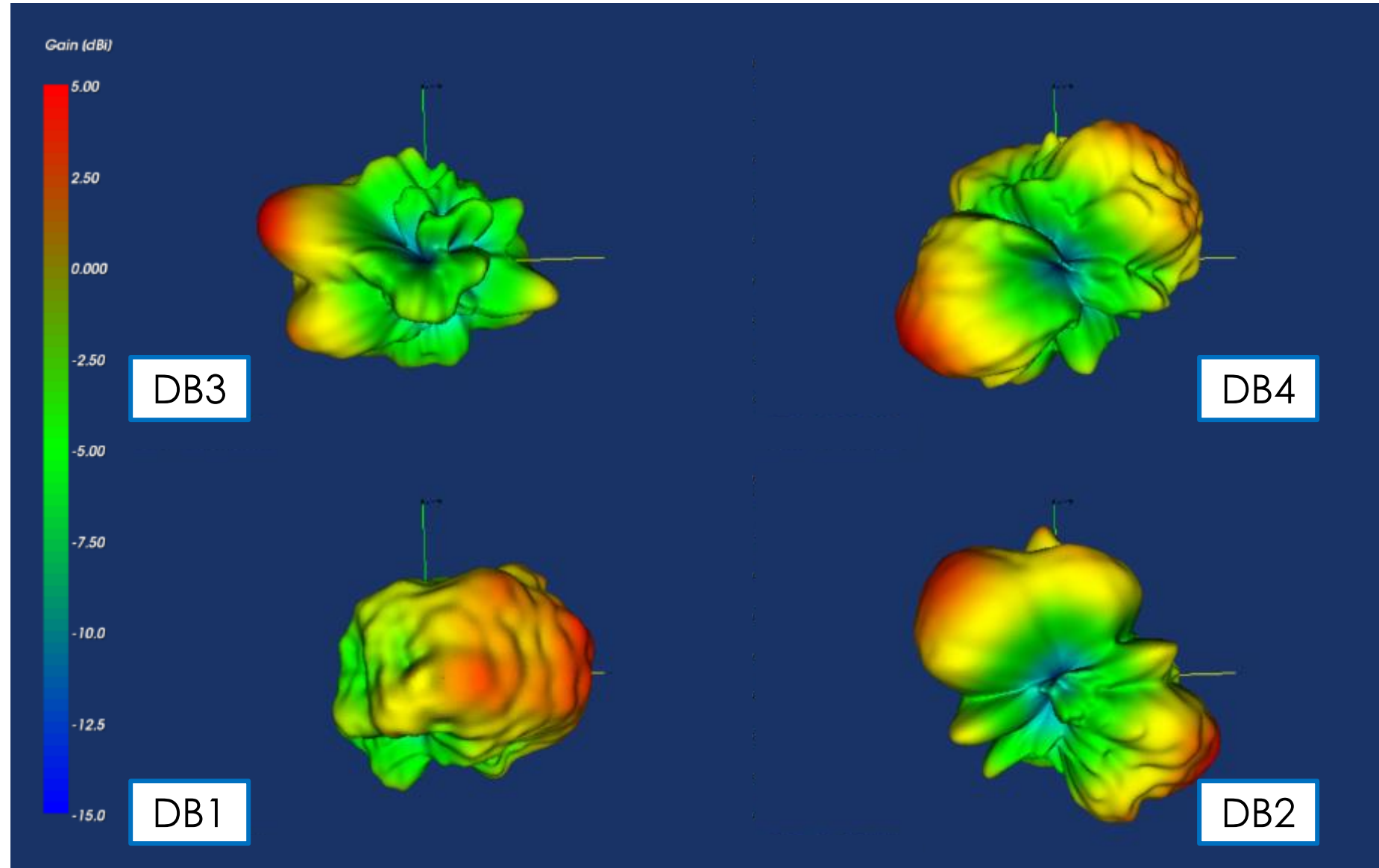
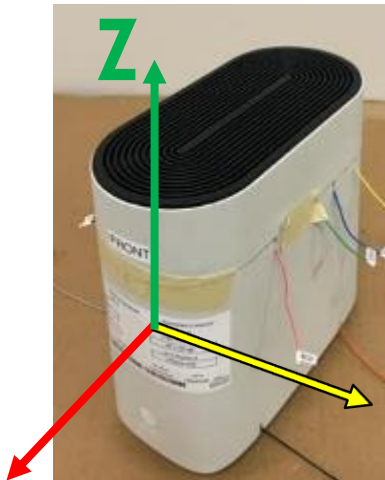
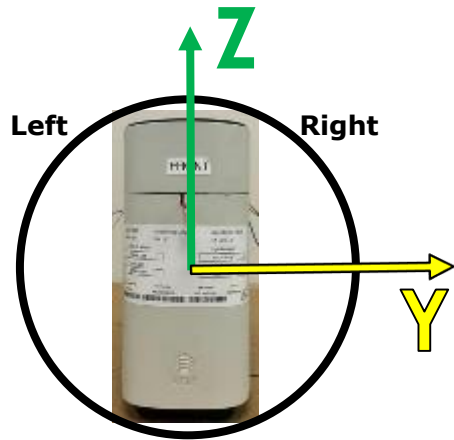
3D Gain Plot – DB Antennas – 2.45 GHz

Front-to-Back

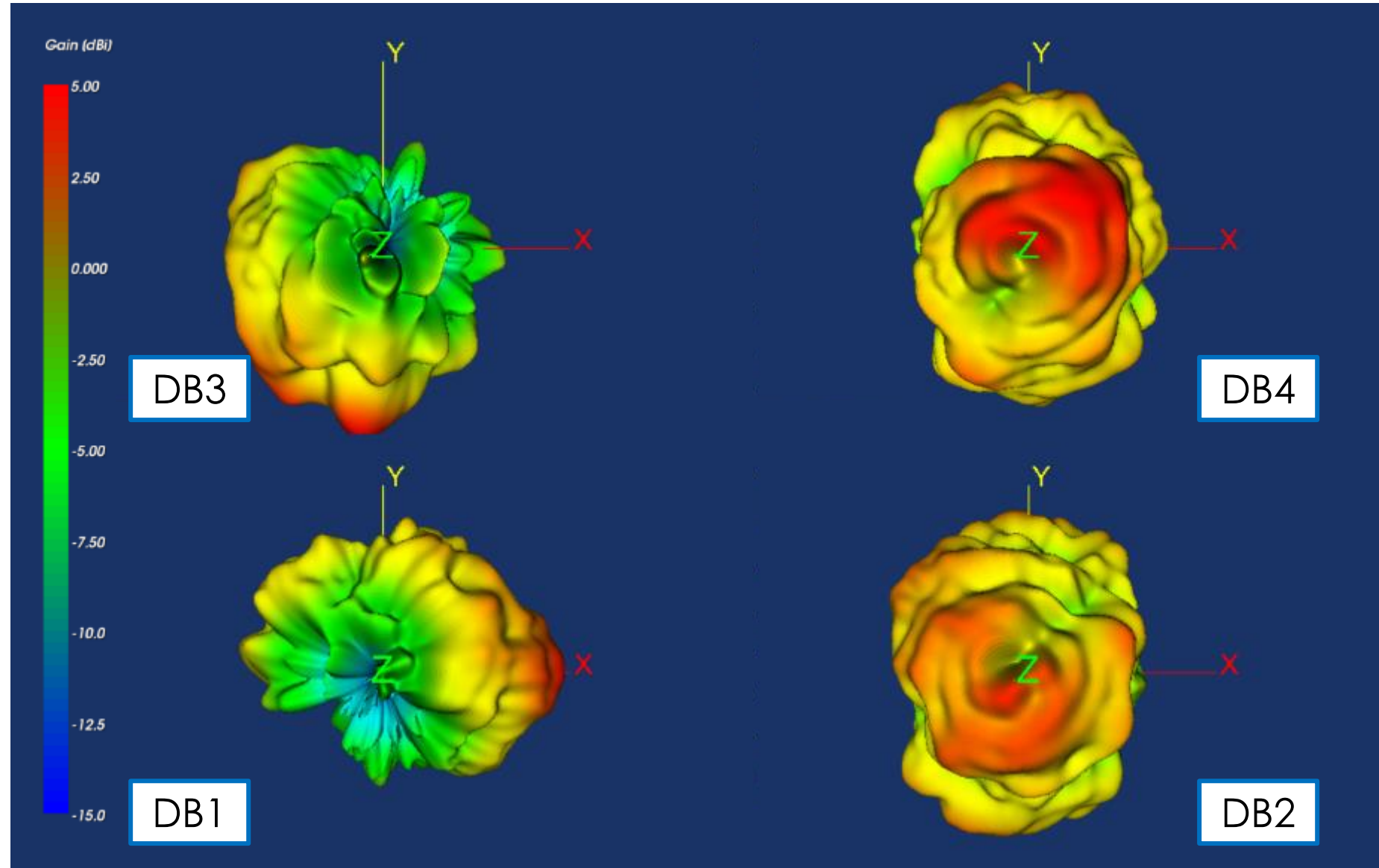
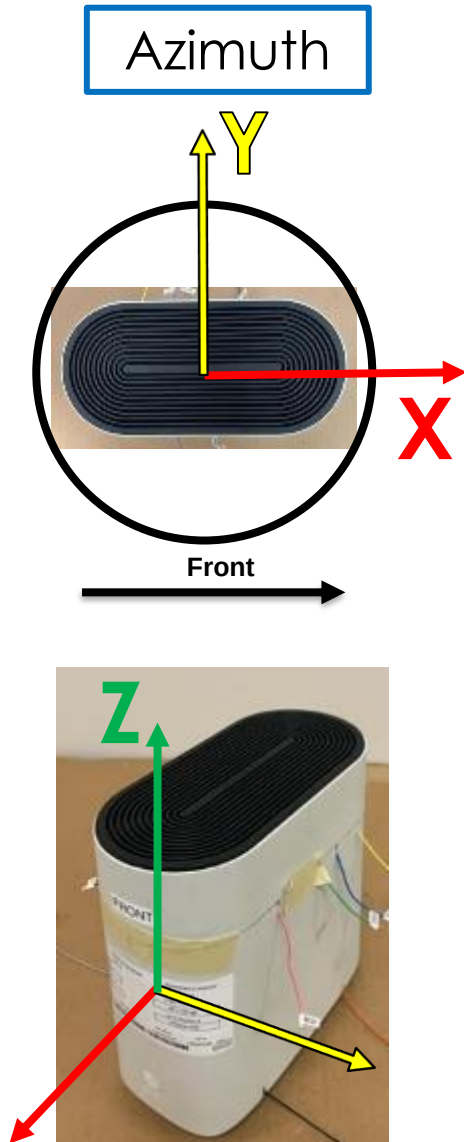


3D Gain Plot – DB Antennas – 2.45 GHz

Side-to-Side

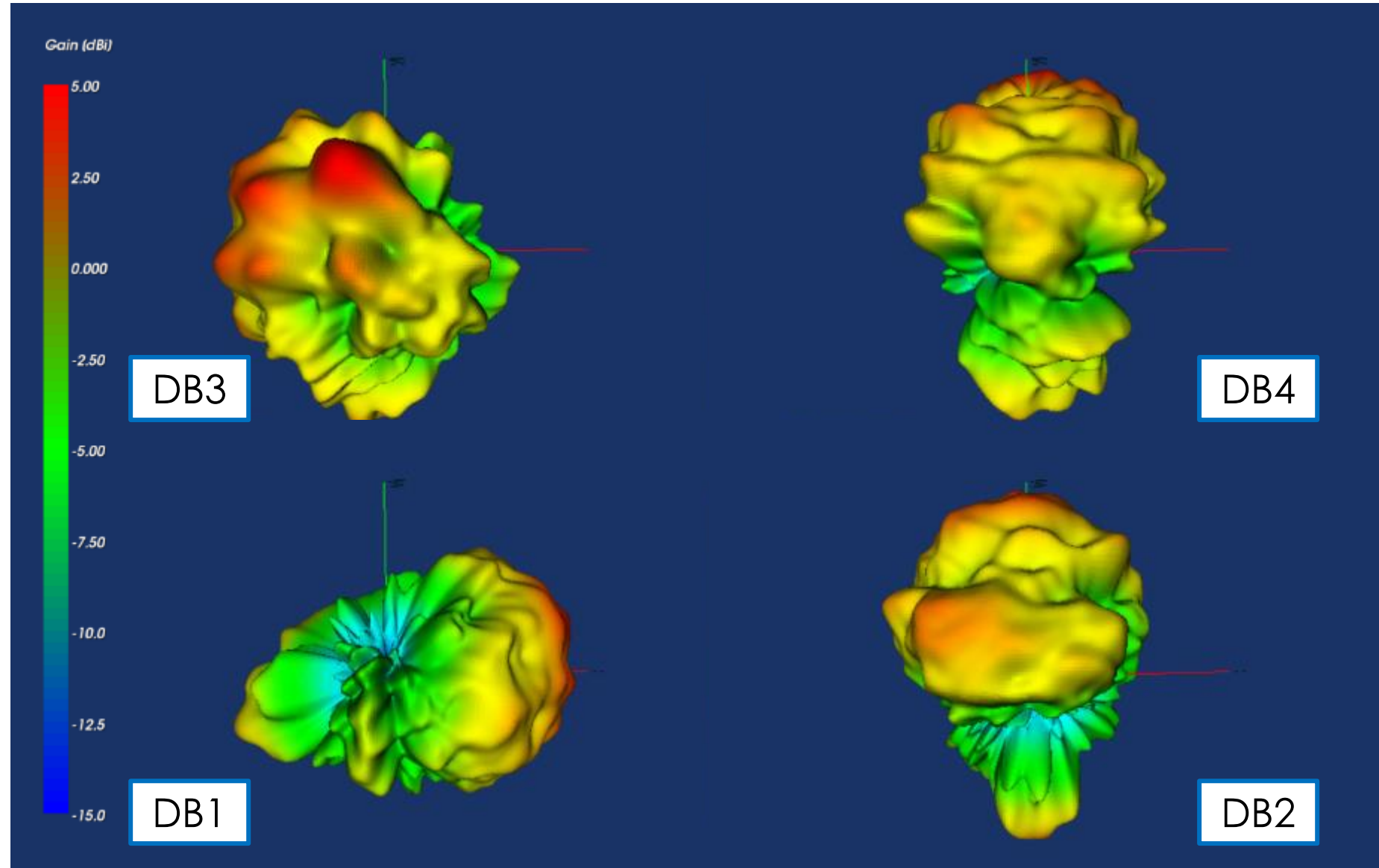
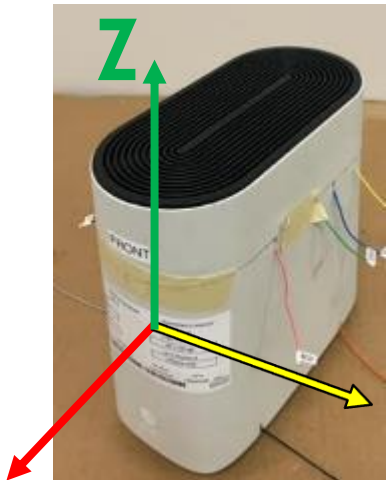
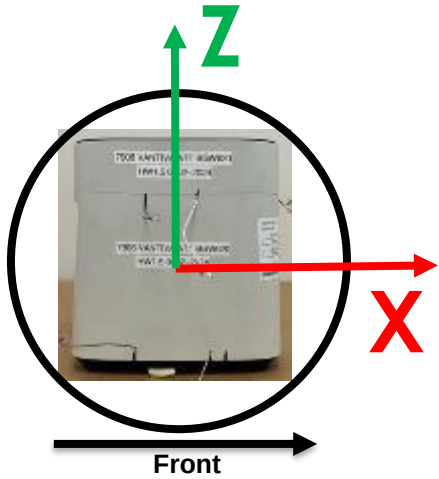


3D Gain Plot – DB Antennas – 5.25 GHz



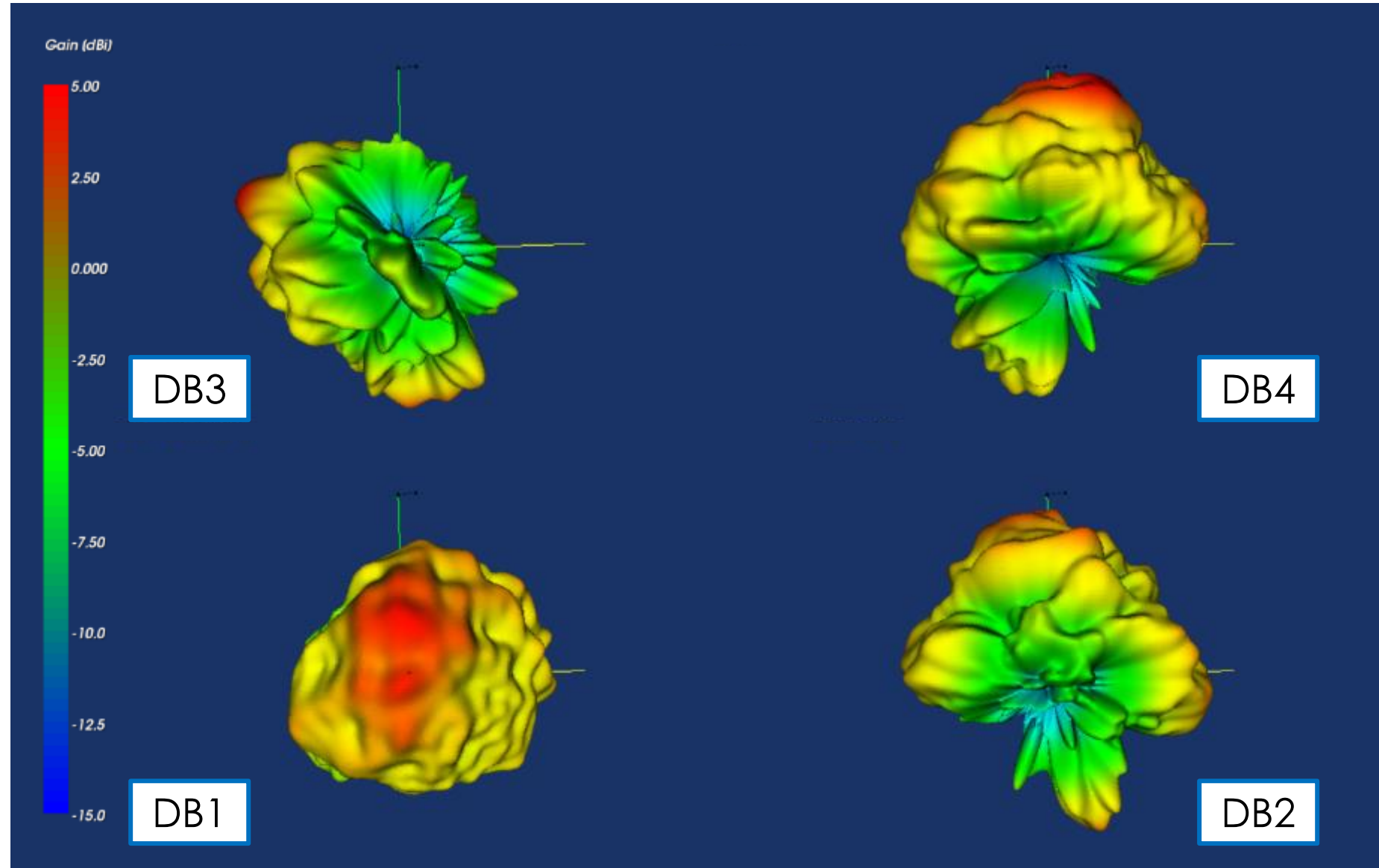
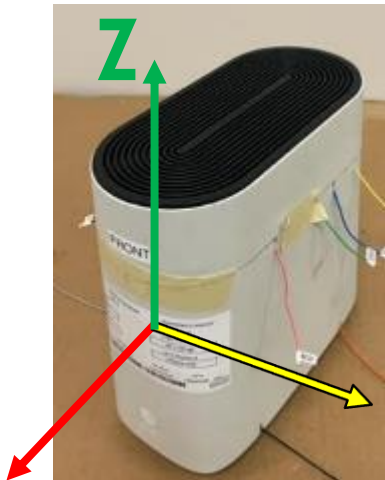
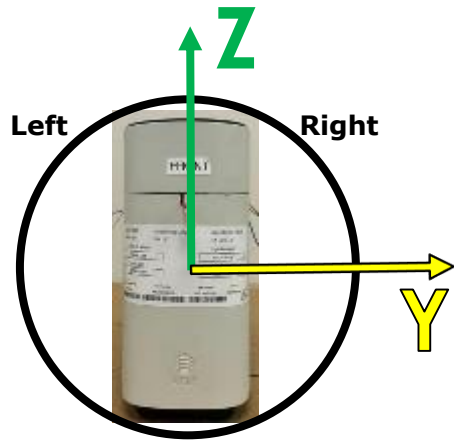
3D Gain Plot – DB Antennas – 5.25 GHz

Front-to-Back

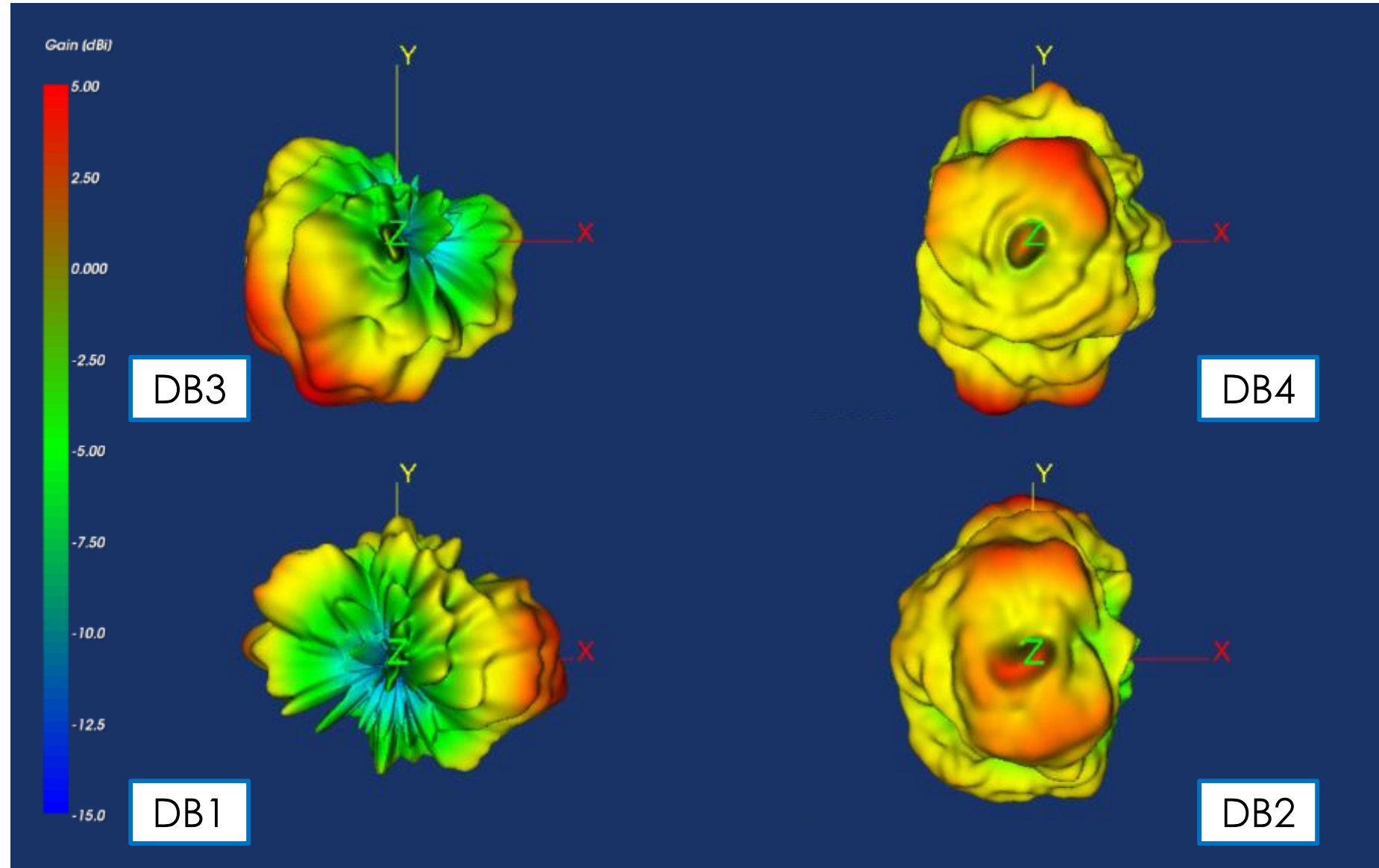
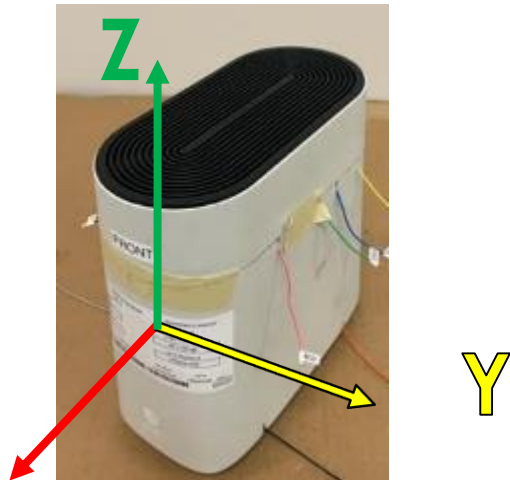
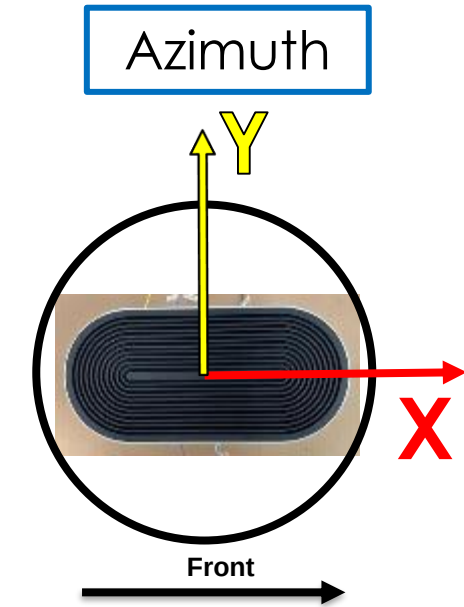


3D Gain Plot – DB Antennas – 5.25 GHz

Side-to-Side

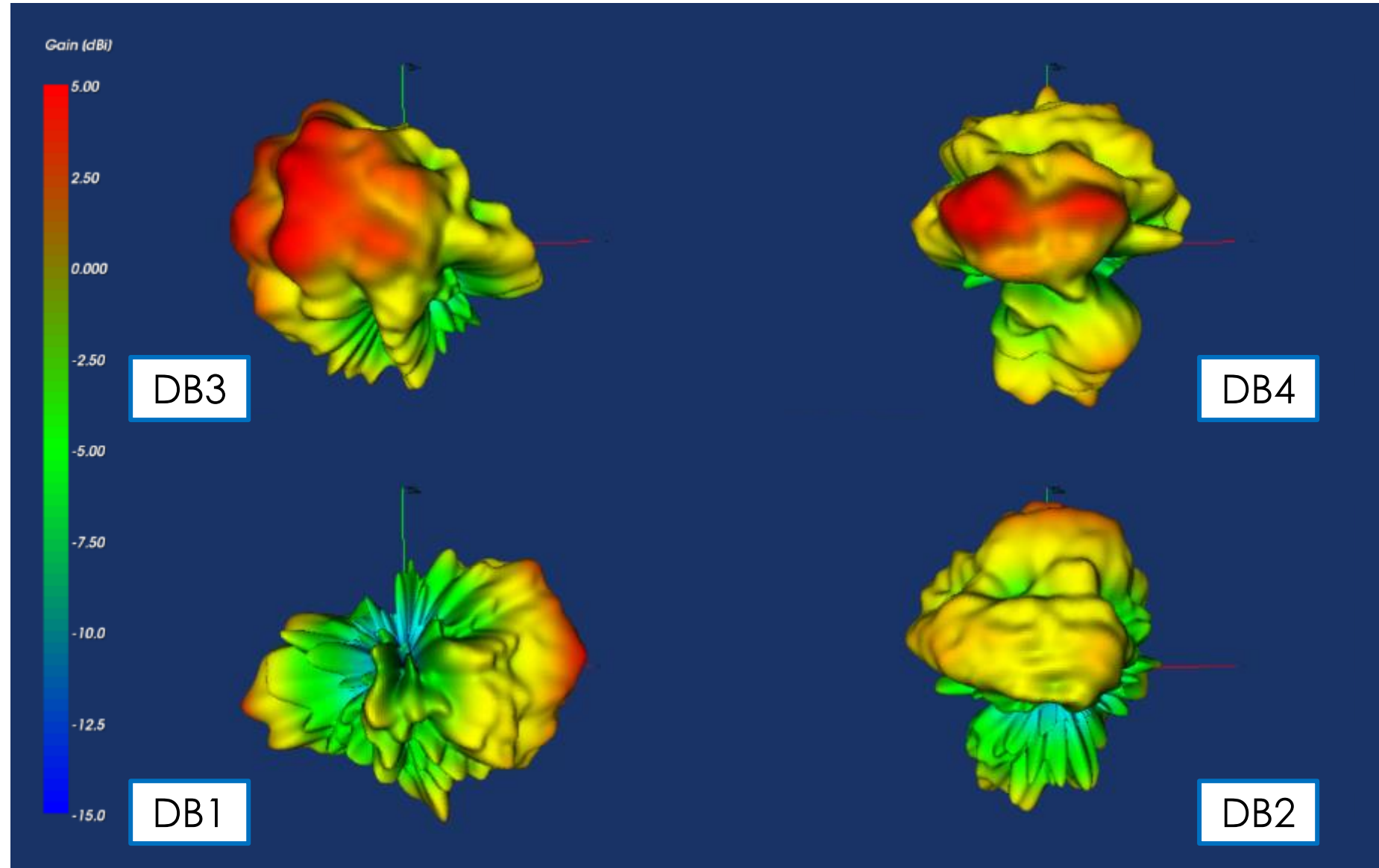
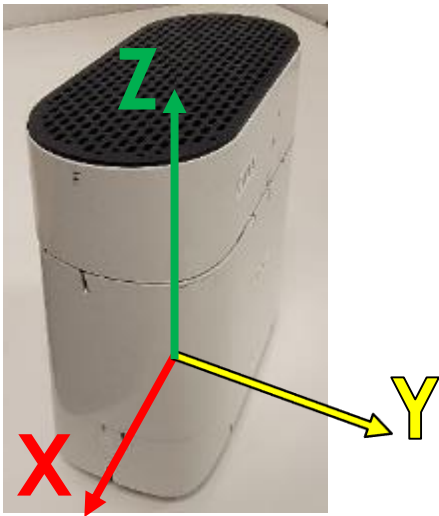
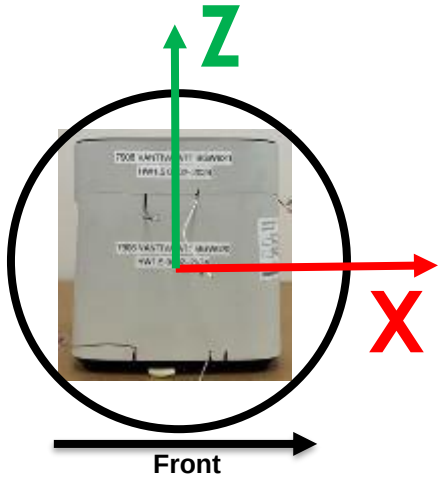


3D Gain Plot – DB Antennas – 5.725 GHz



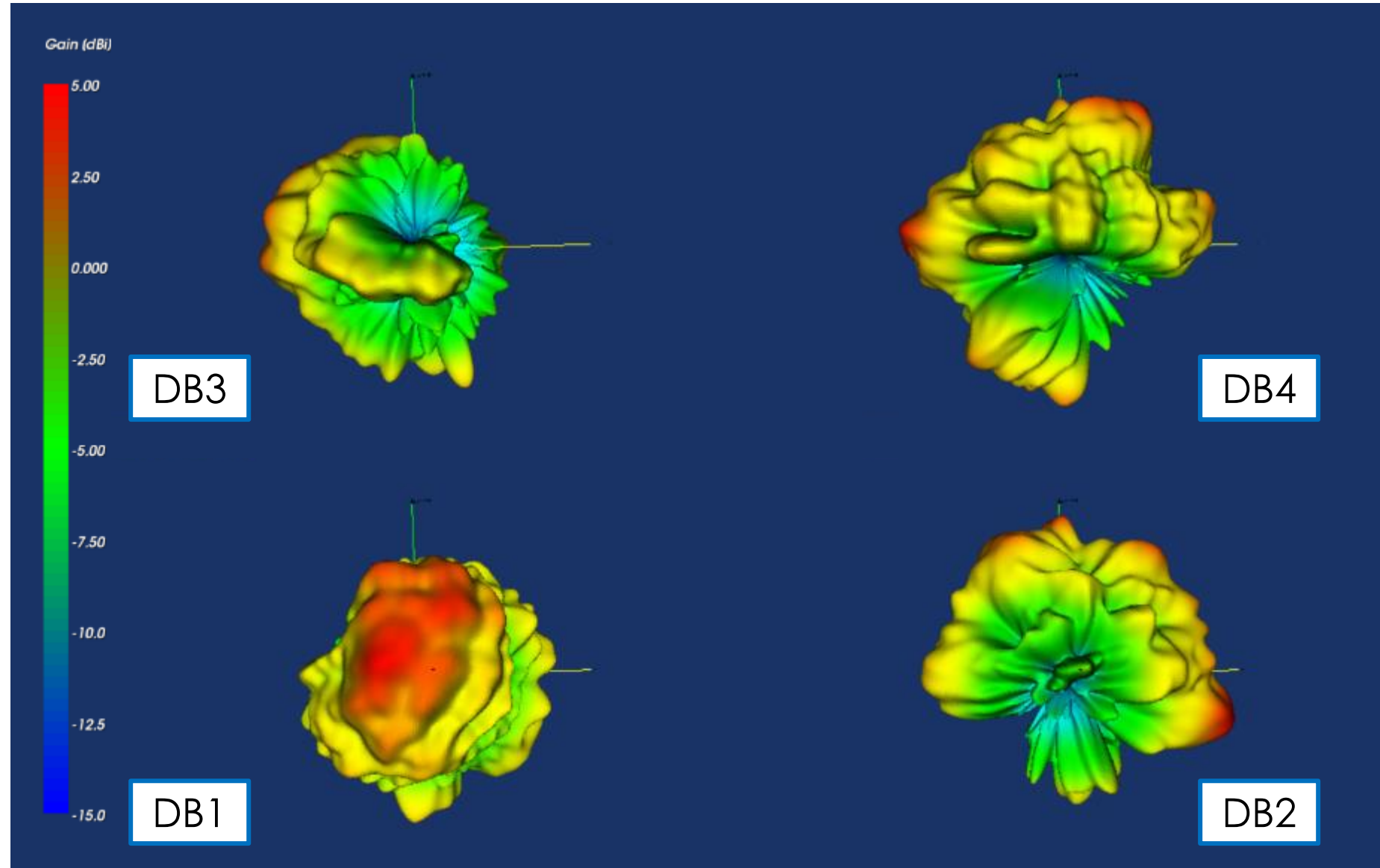
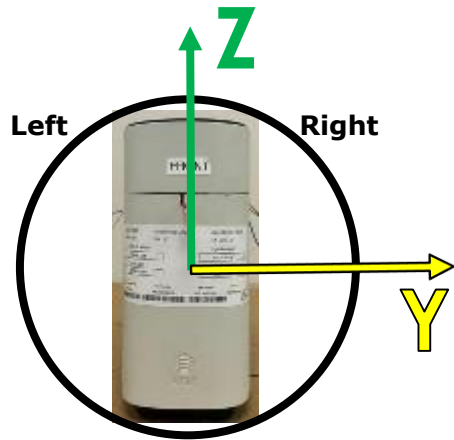
3D Gain Plot – DB Antennas – 5.725 GHz

Front-to-Back

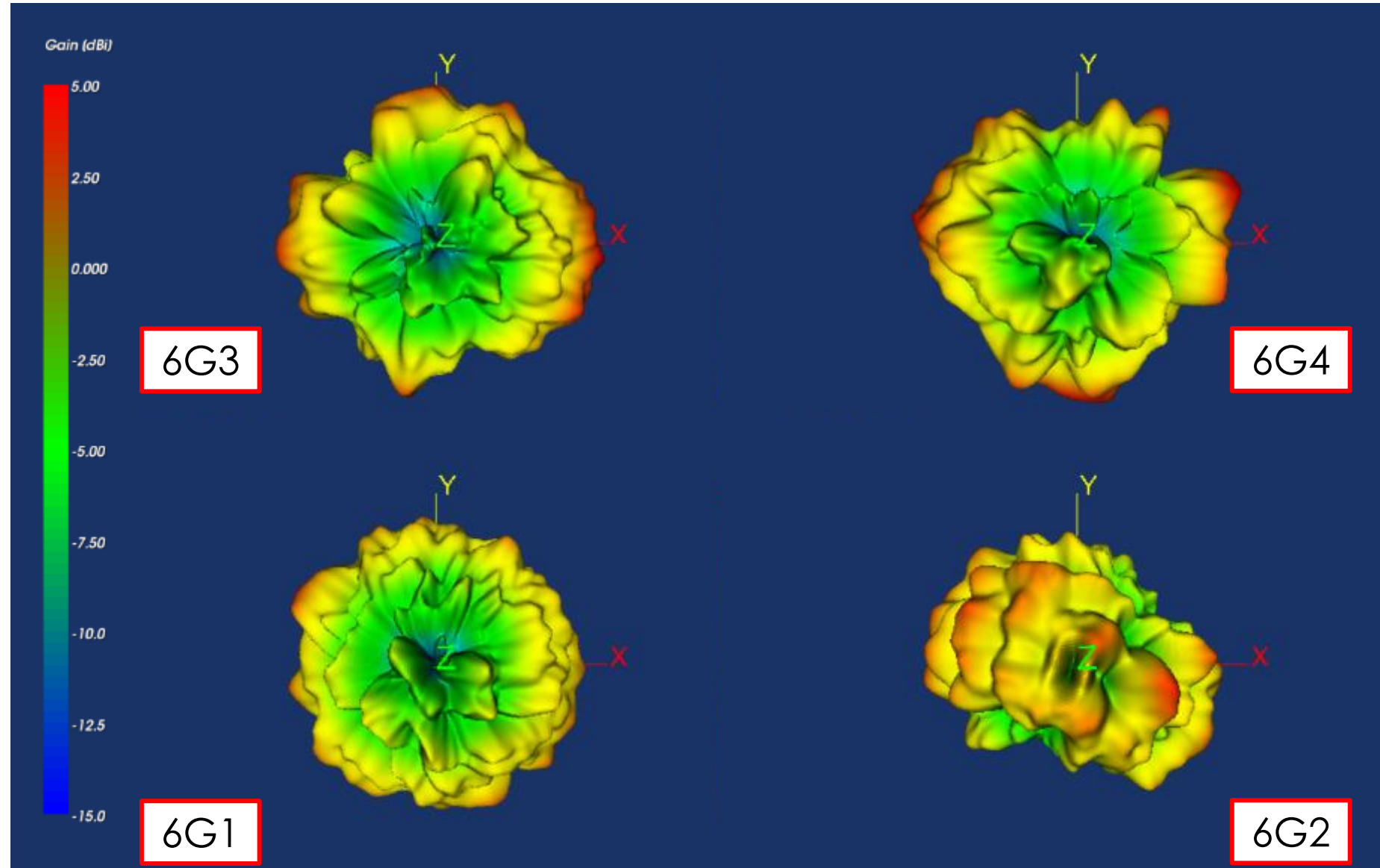
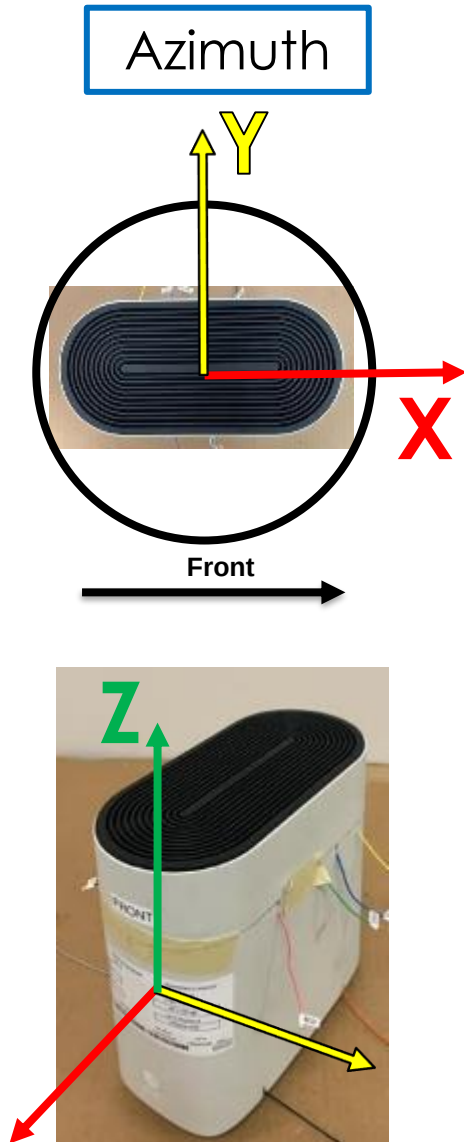


3D Gain Plot – DB Antennas – 5.725 GHz

Side-to-Side

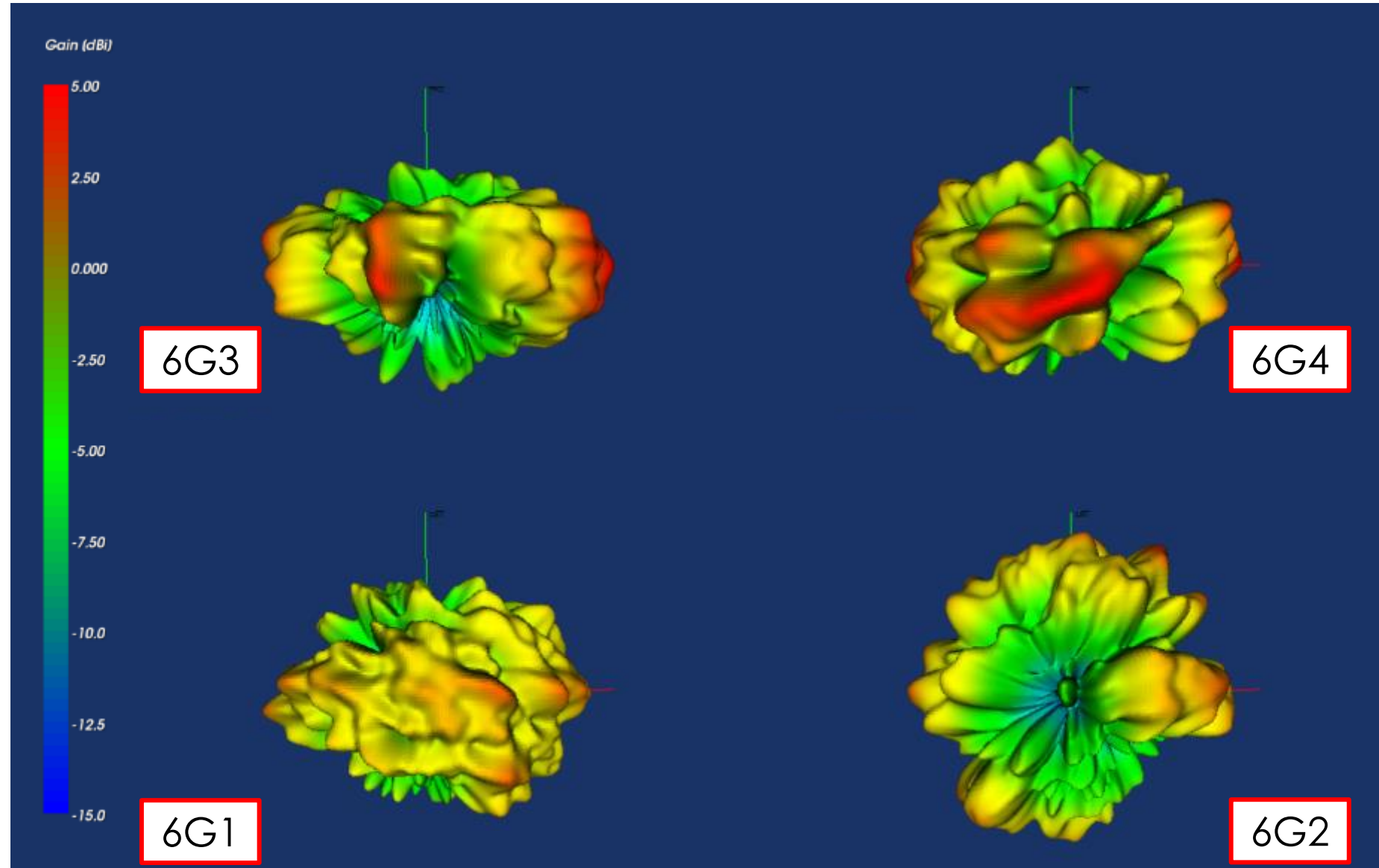
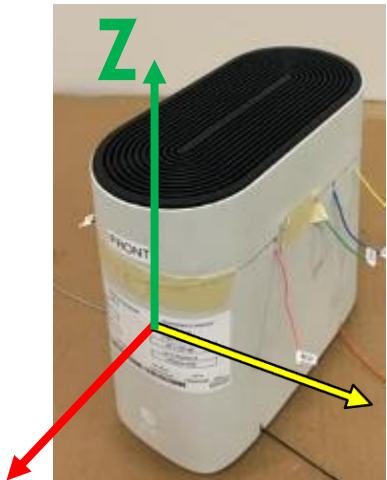
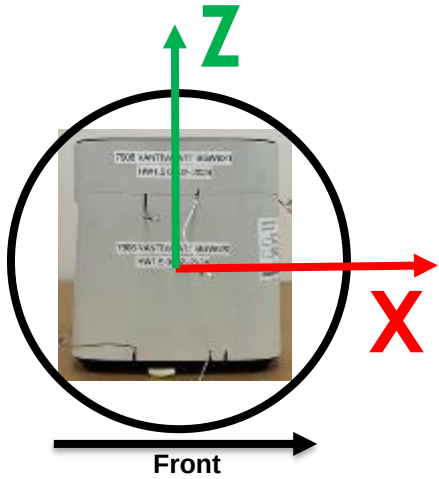


3D Gain Plot – 6 GHz Antennas – 5.925 GHz



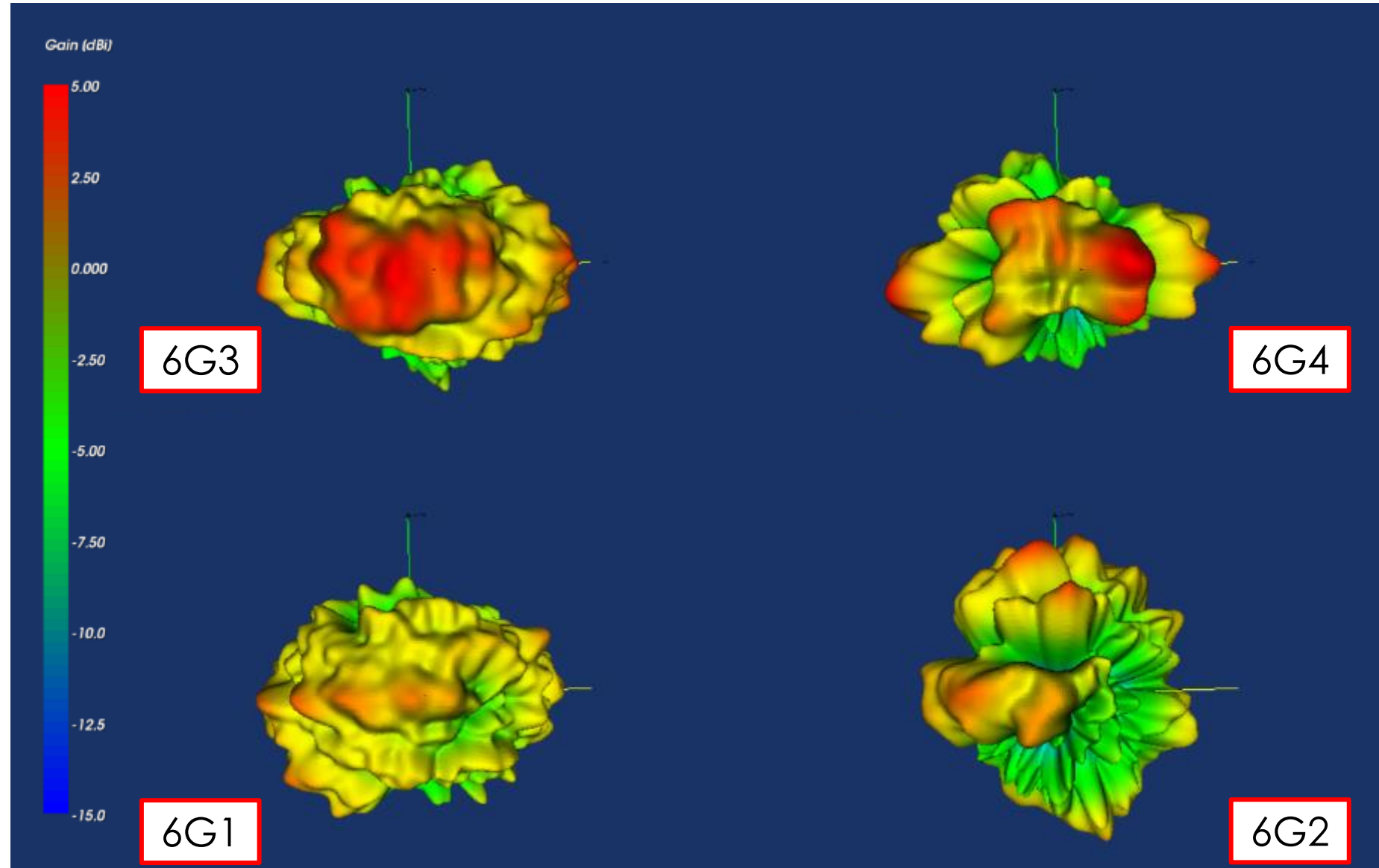
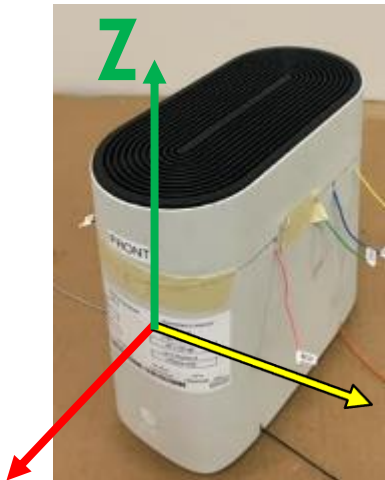
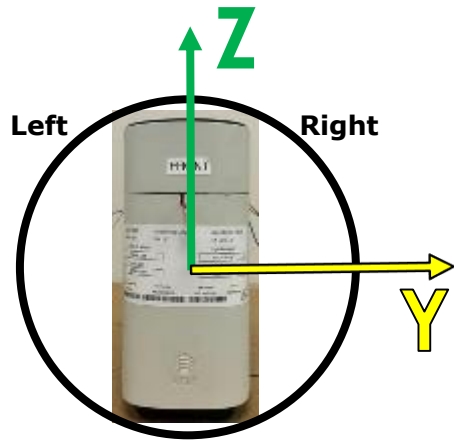
3D Gain Plot – 6 GHz Antennas – 5.925 GHz

Front-to-Back

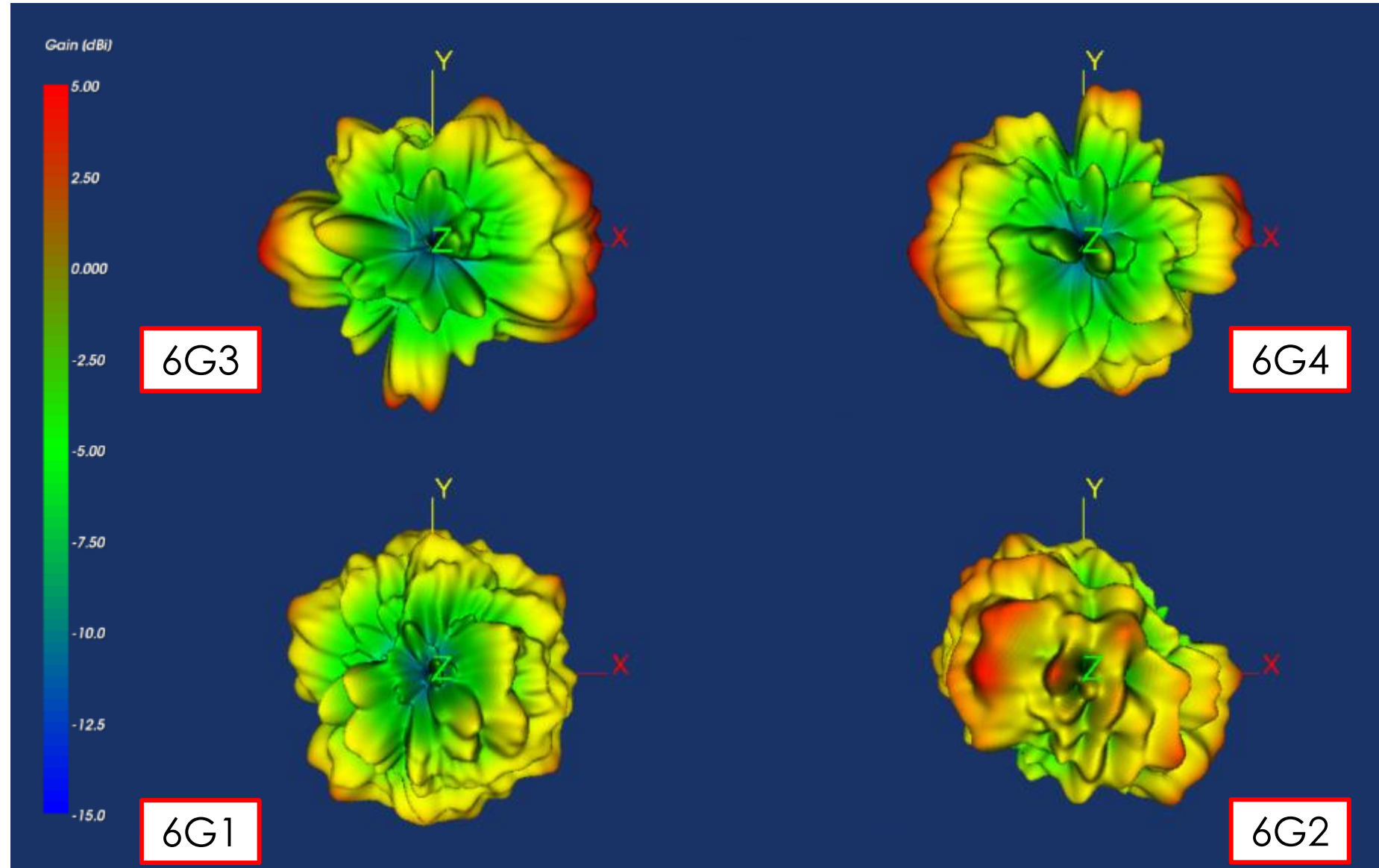
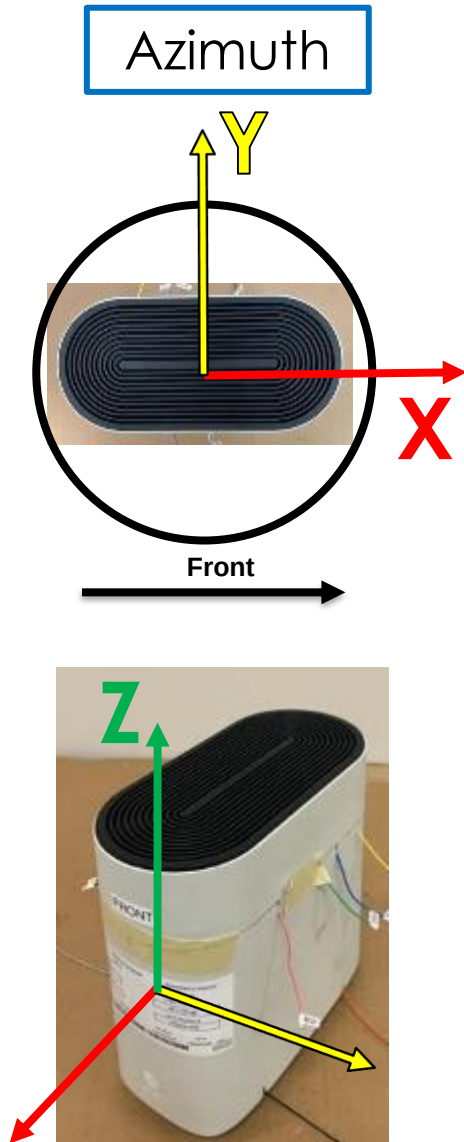


3D Gain Plot – 6 GHz Antennas – 5.925 GHz

Side-to-Side

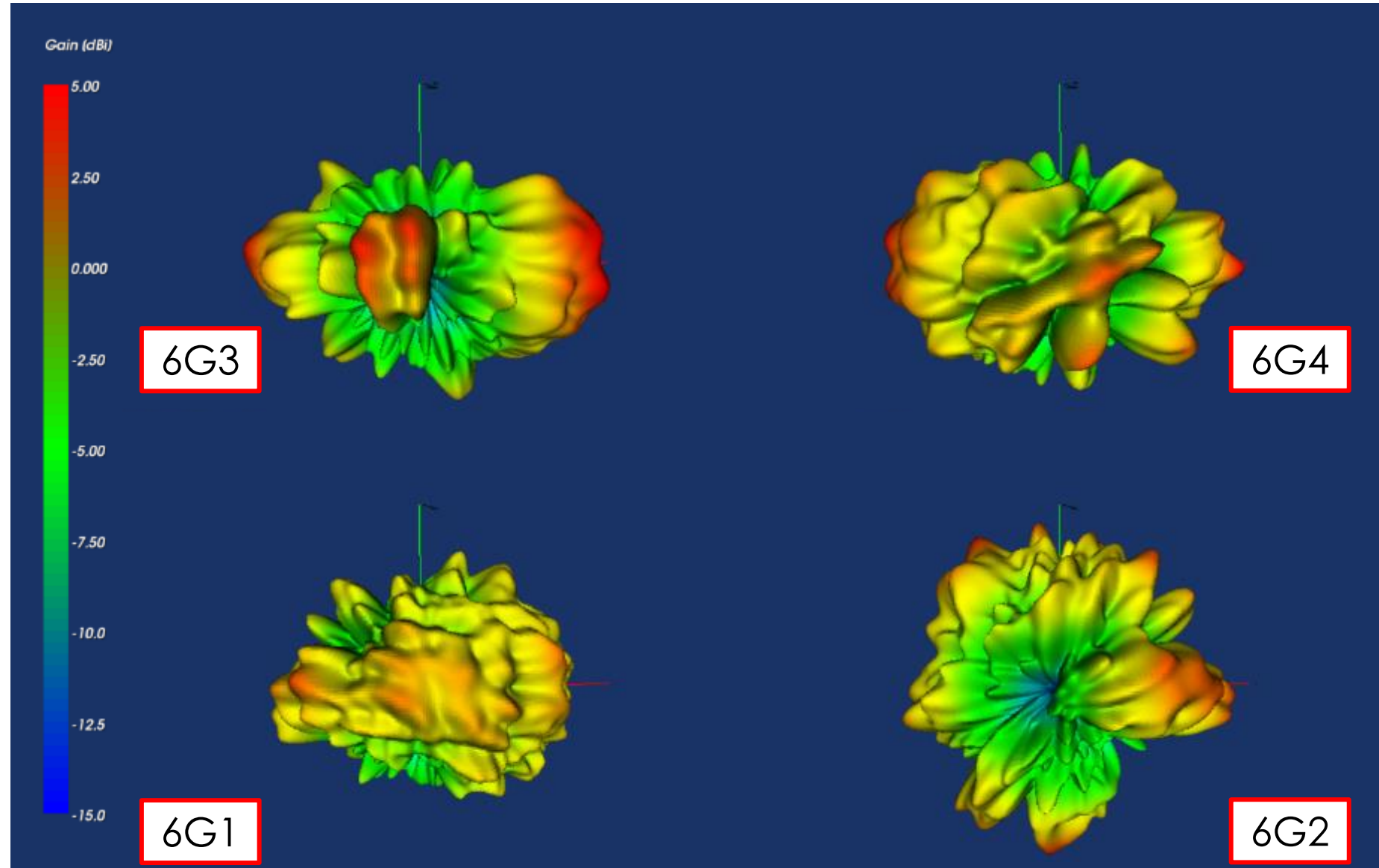
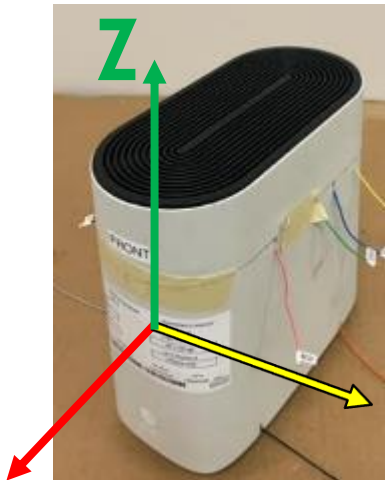
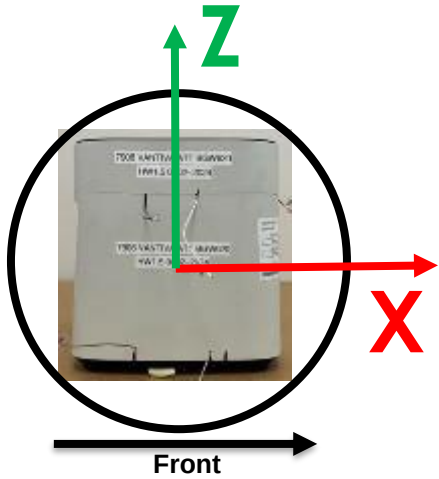


3D Gain Plot – 6 GHz Antennas – 6.5 GHz



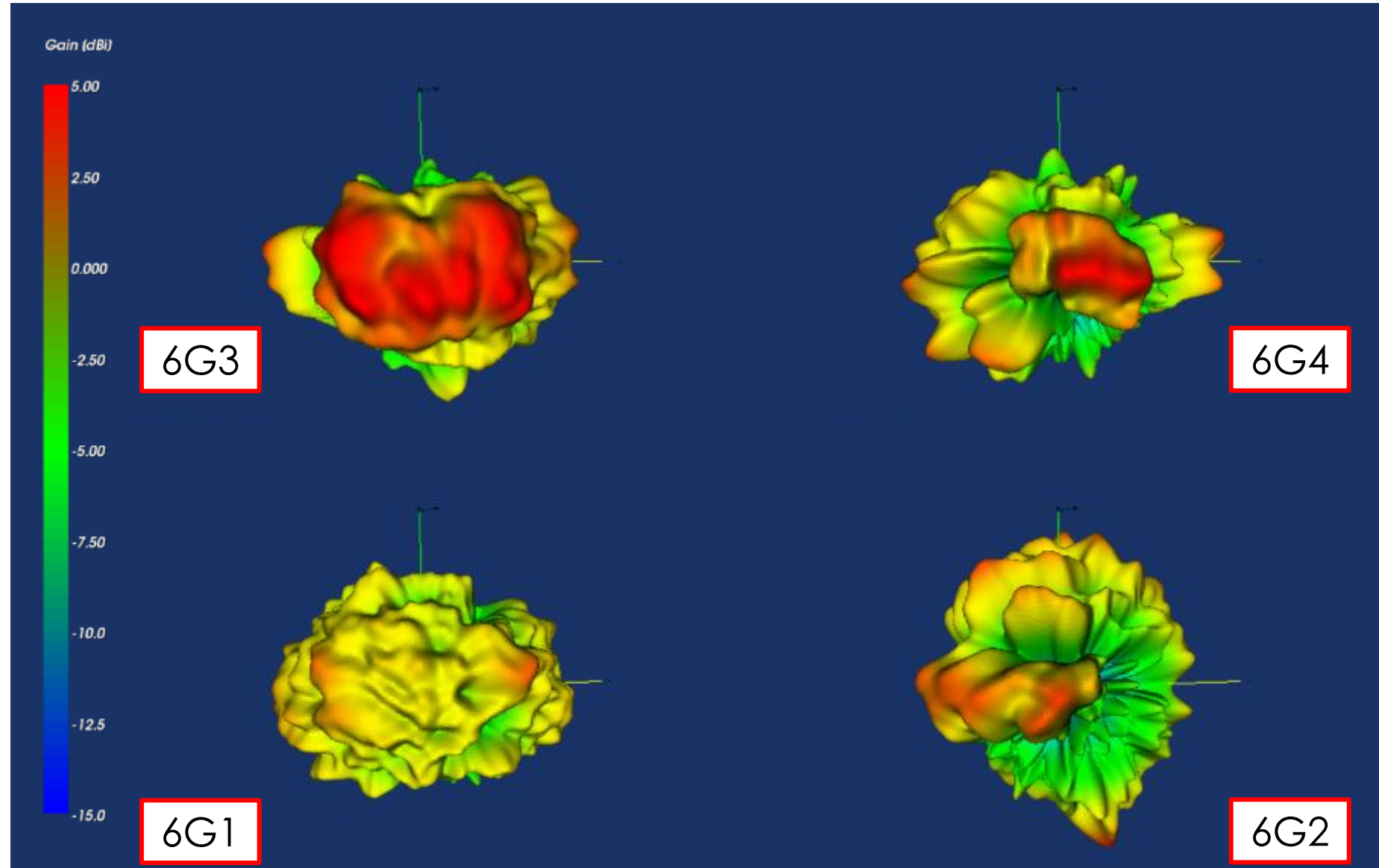
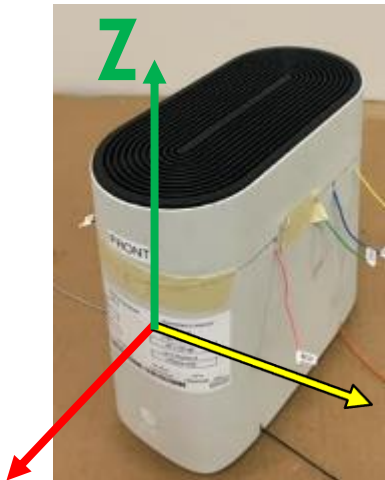
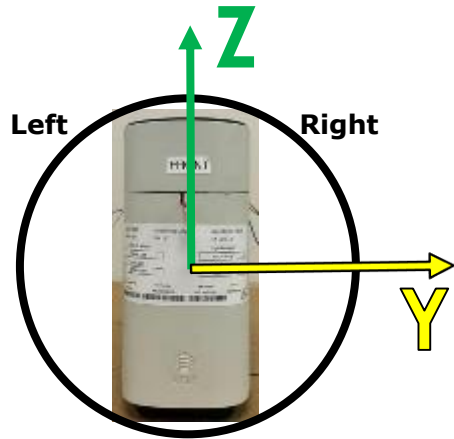
3D Gain Plot – 6 GHz Antennas – 6.5 GHz

Front-to-Back

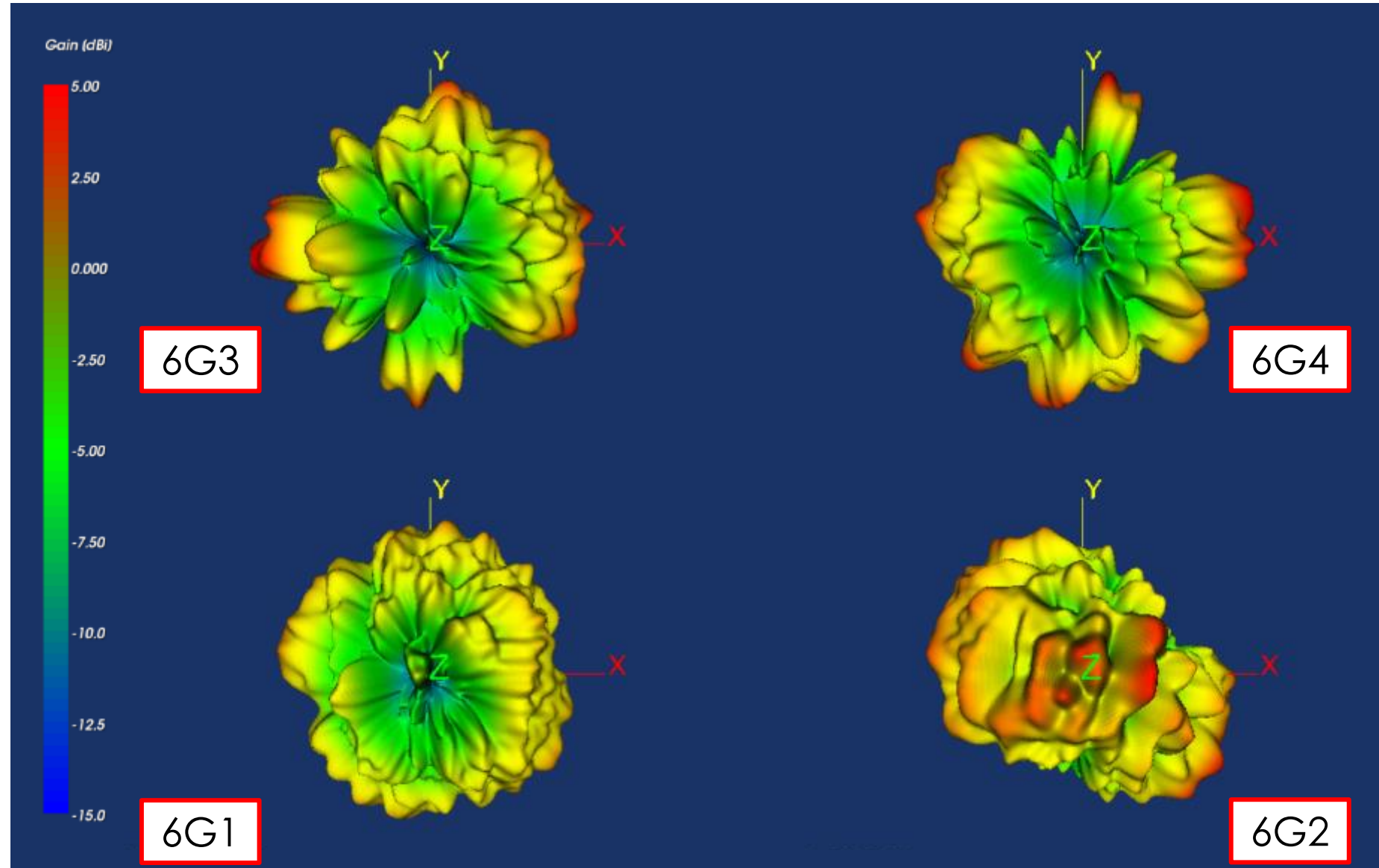
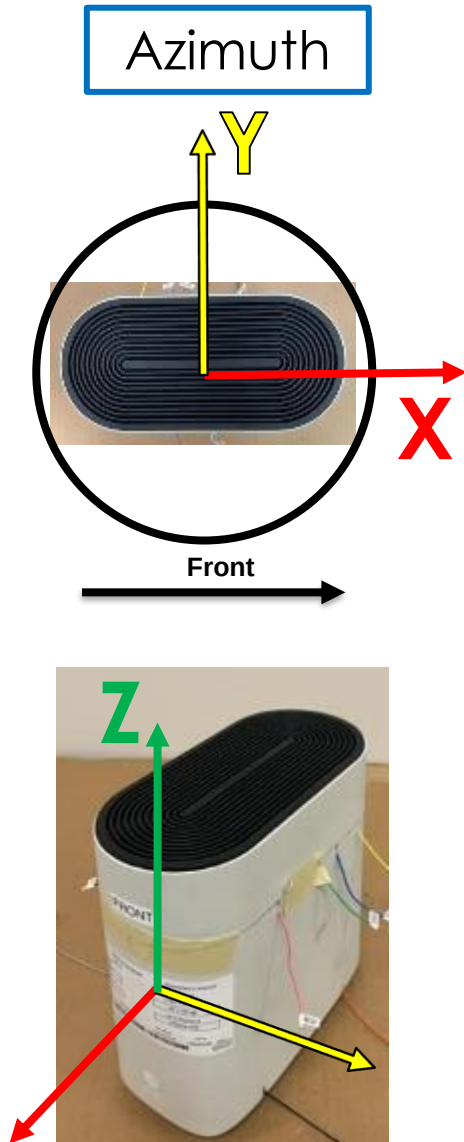


3D Gain Plot – 6 GHz Antennas – 6.5 GHz

Side-to-Side

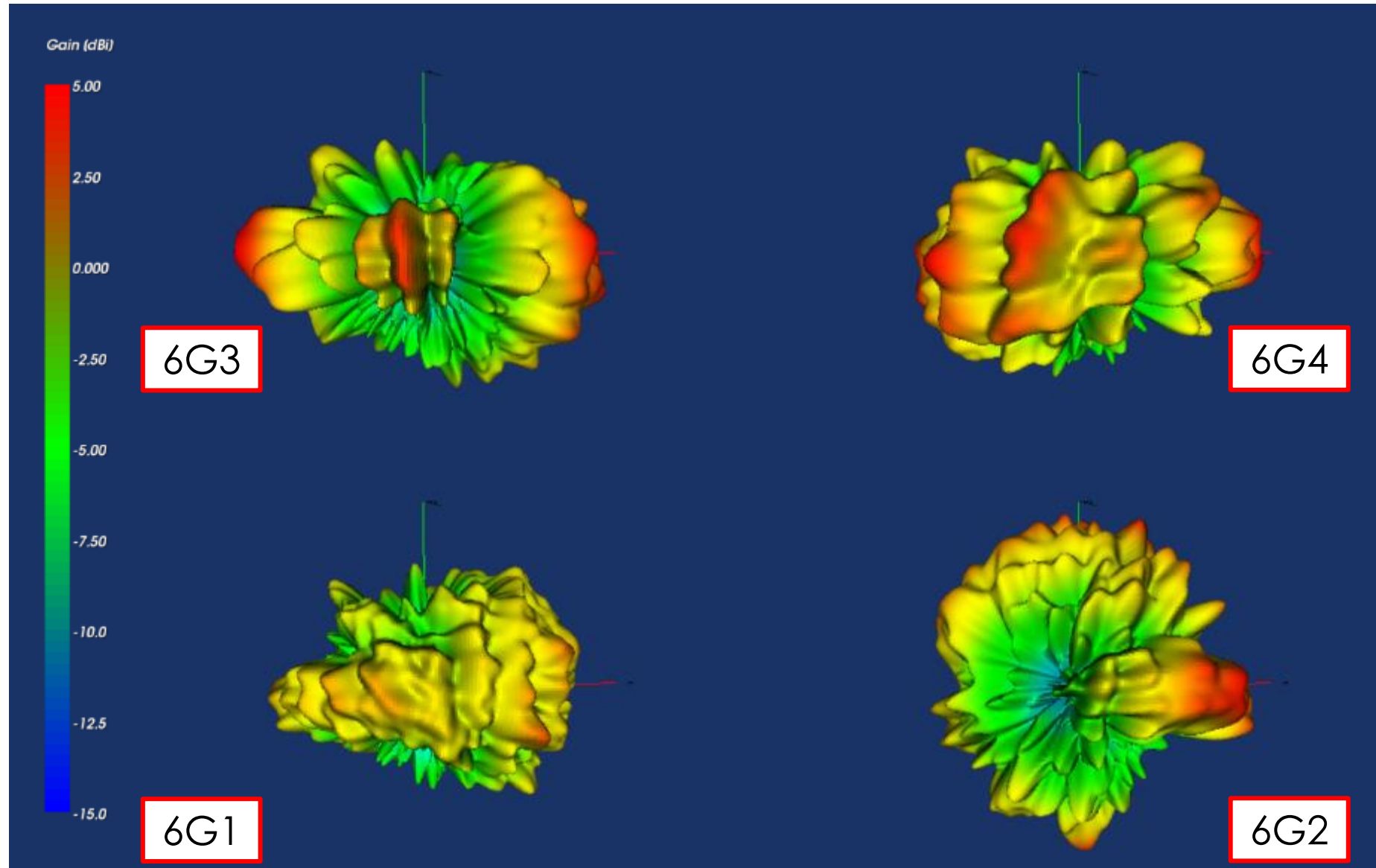
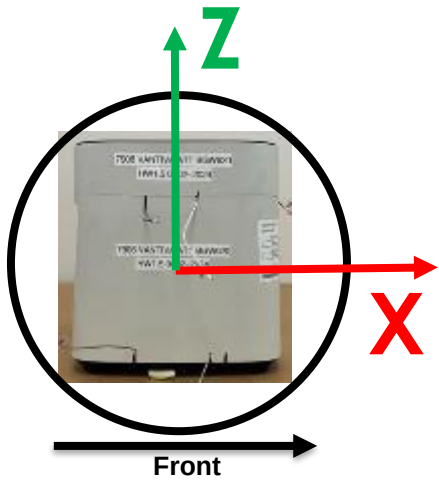


3D Gain Plot – 6 GHz Antennas – 7.125 GHz



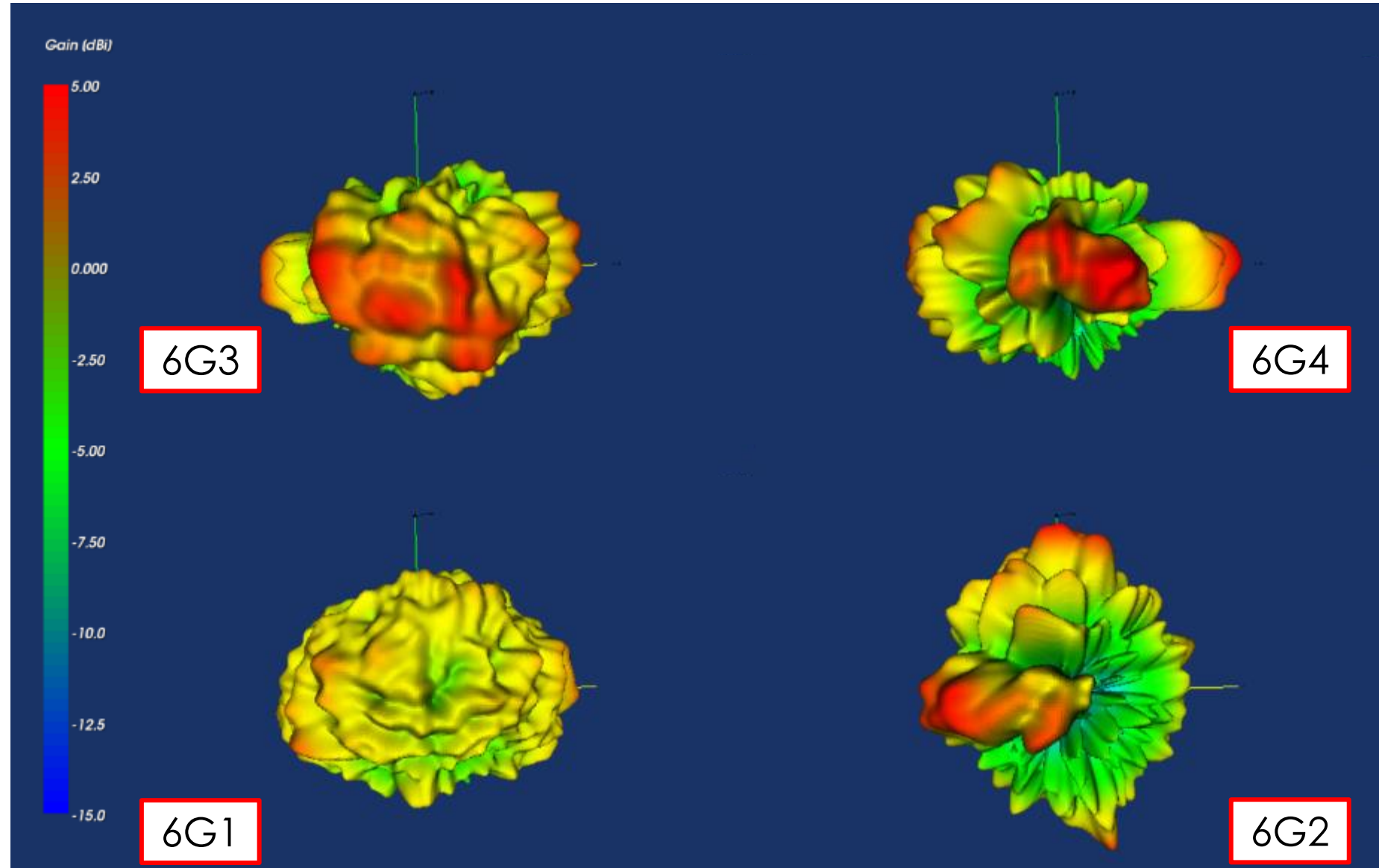
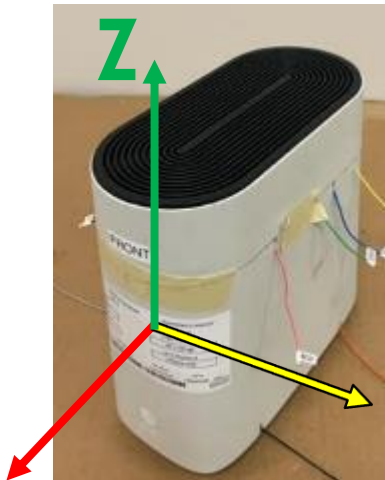
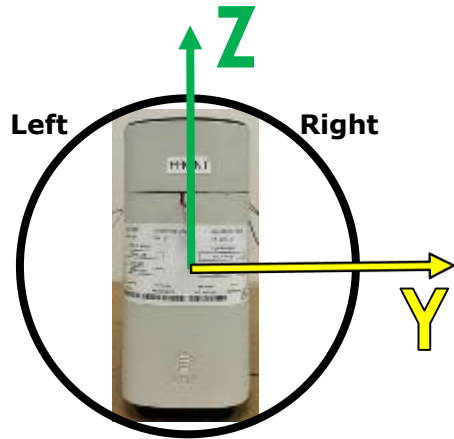
3D Gain Plot – 6 GHz Antennas – 7.125 GHz

Front-to-Back

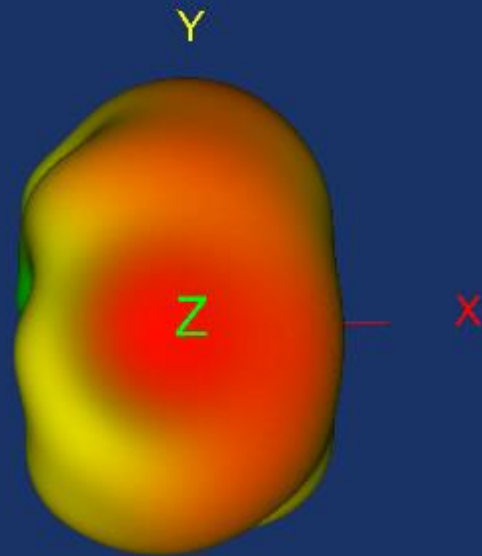
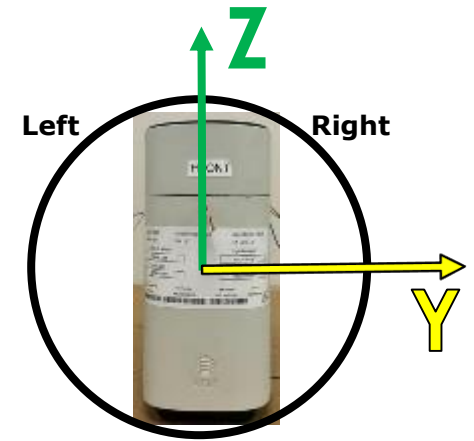
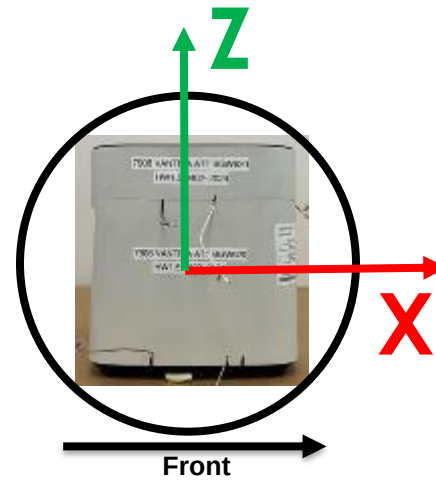
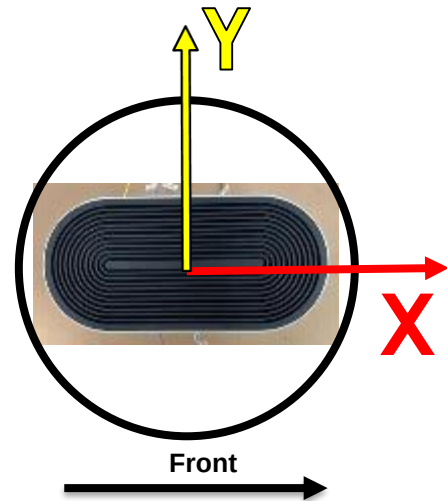


3D Gain Plot – 6 GHz Antennas – 7.125 GHz

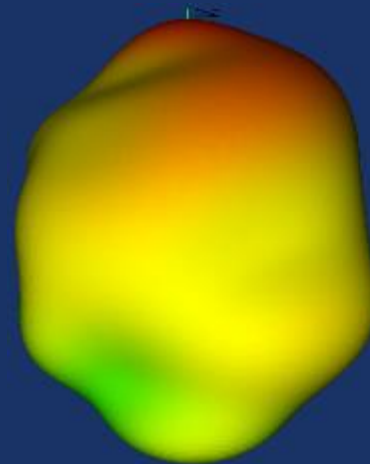
Side-to-Side



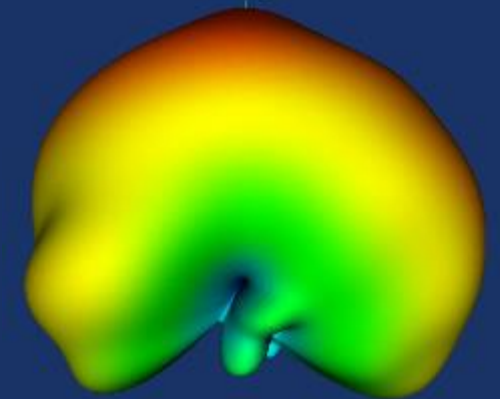
3D Gain Plot – GNSS Antenna – 1.575 GHz



Azimuth

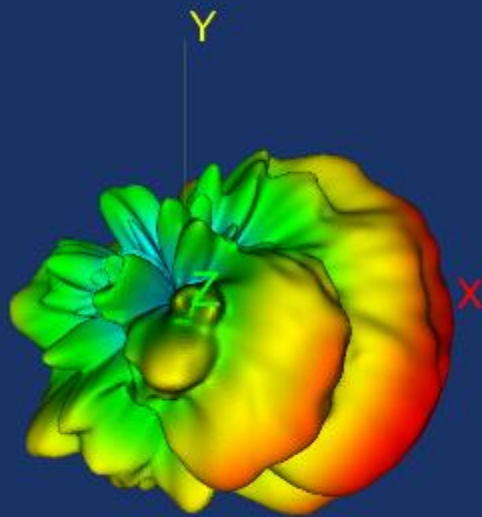
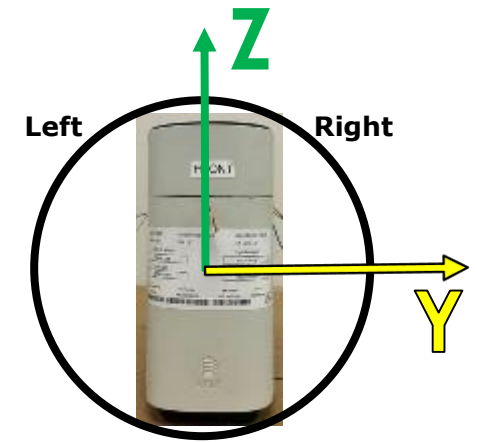
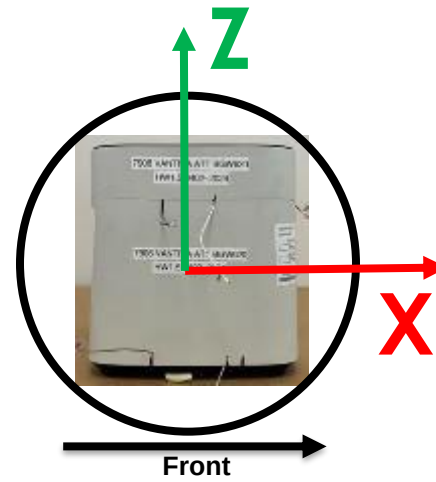
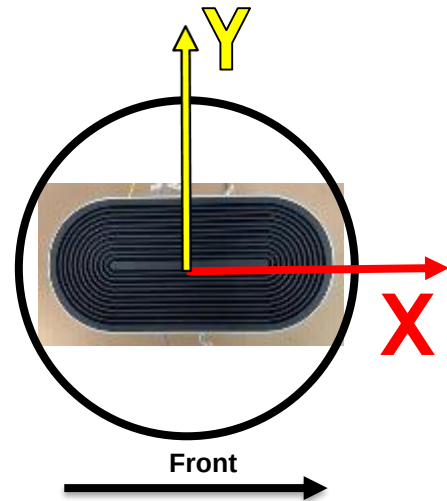


Front-to-Back

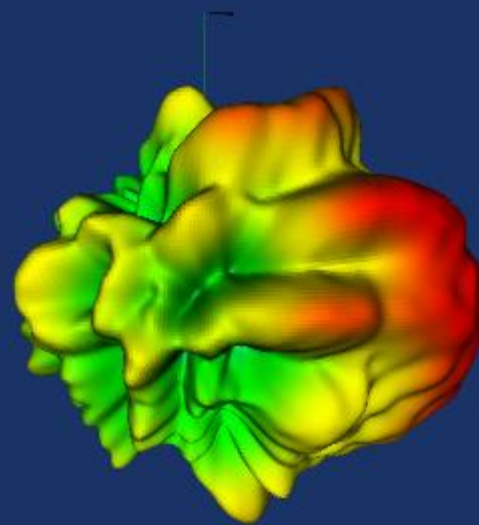


Side-to-Side

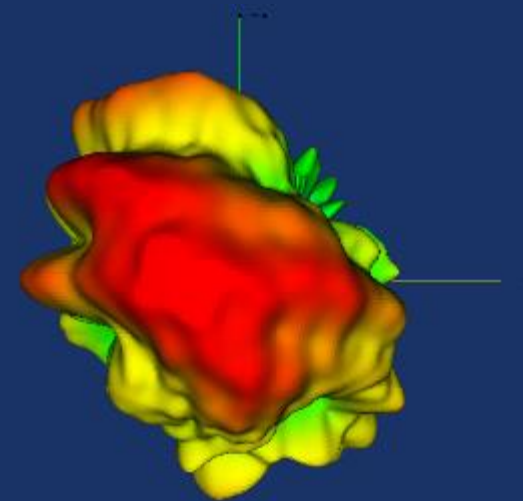
3D Gain Plot – DFS 5 GHz Antenna – 5.25 GHz



Azimuth

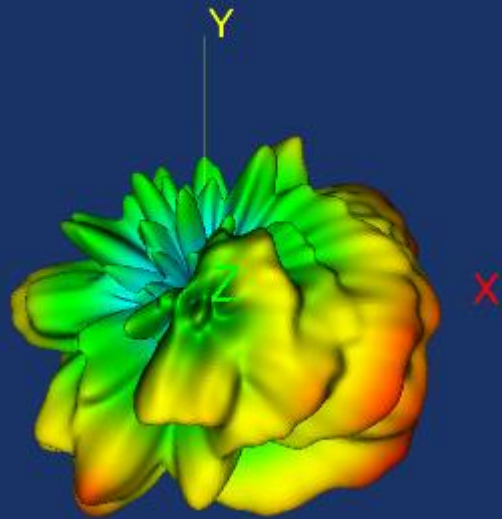
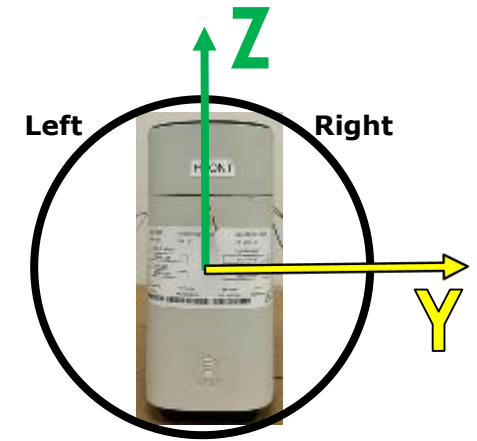
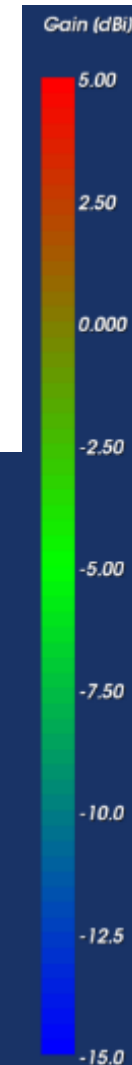
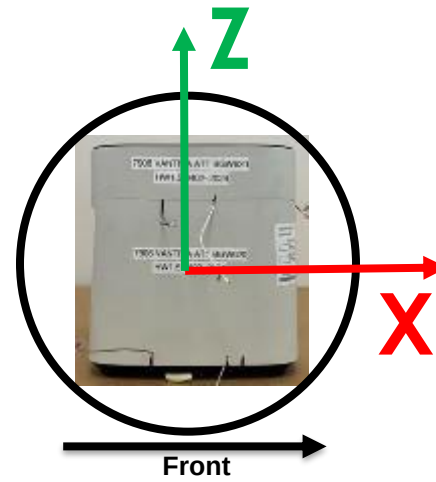
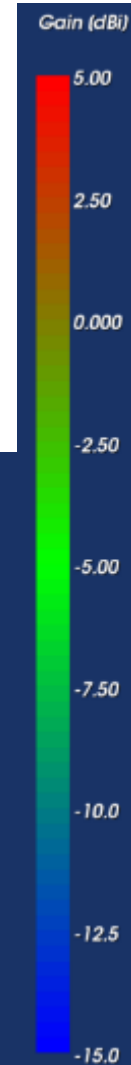
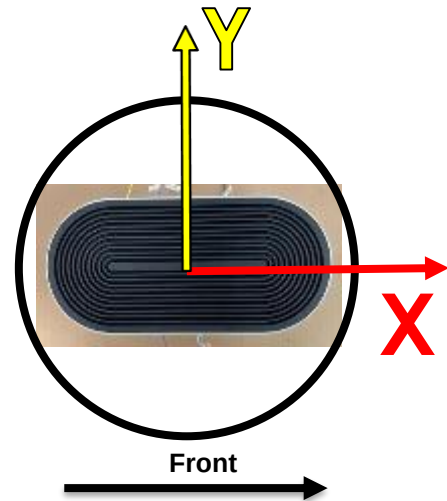


Front-to-Back

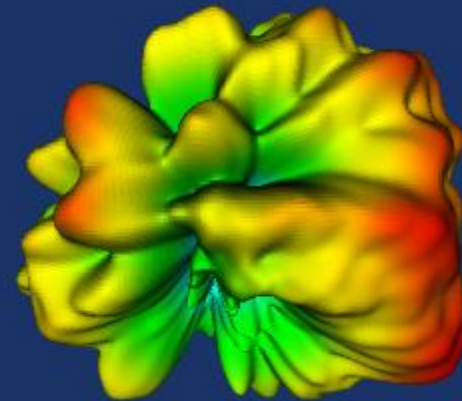


Side-to-Side

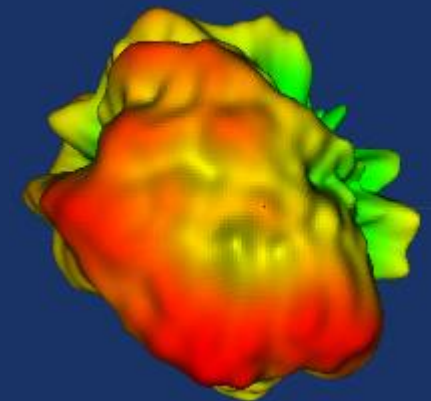
3D Gain Plot – DFS 5 GHz Antenna – 5.725 GHz



Azimuth

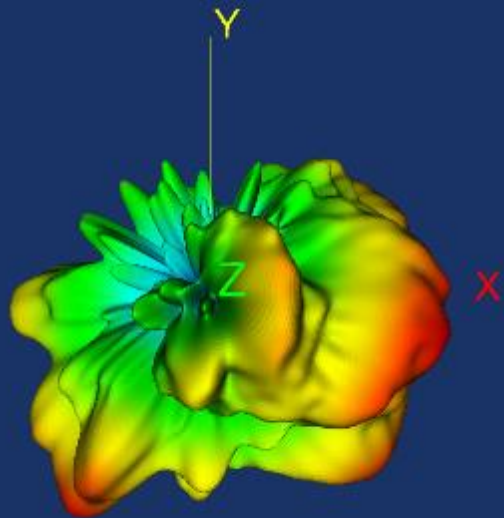
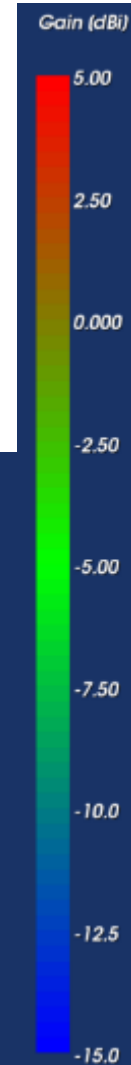
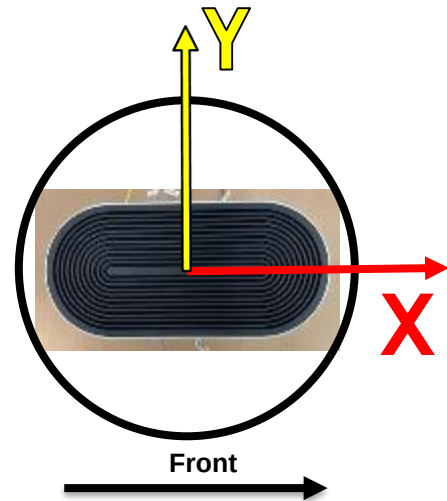


Front-to-Back

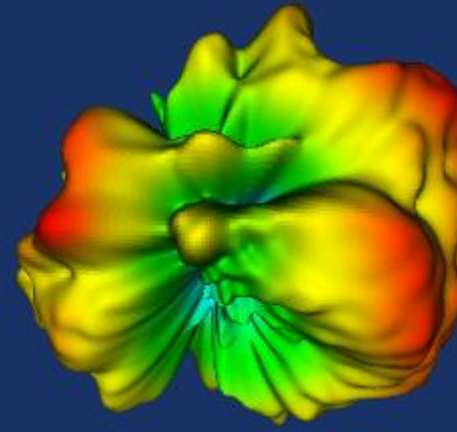
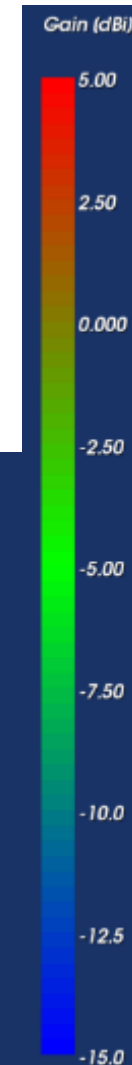
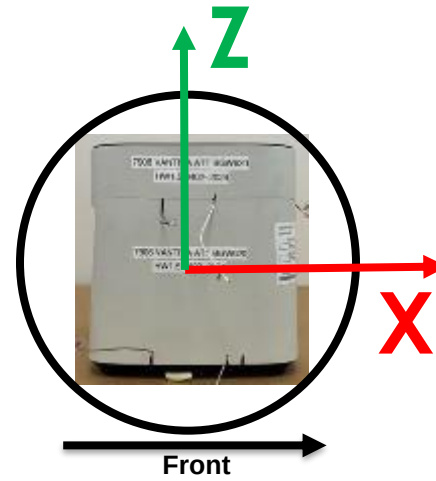


Side-to-Side

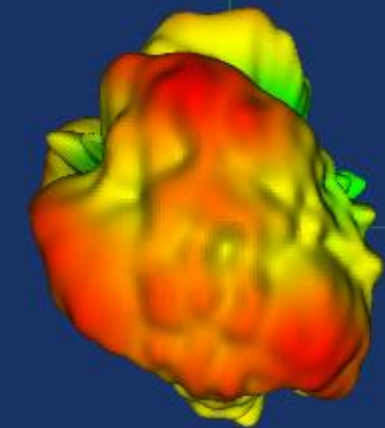
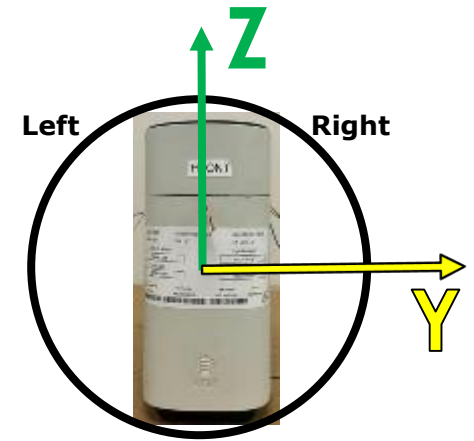
3D Gain Plot – DFS 6 GHz Antenna – 5.925 GHz



Azimuth

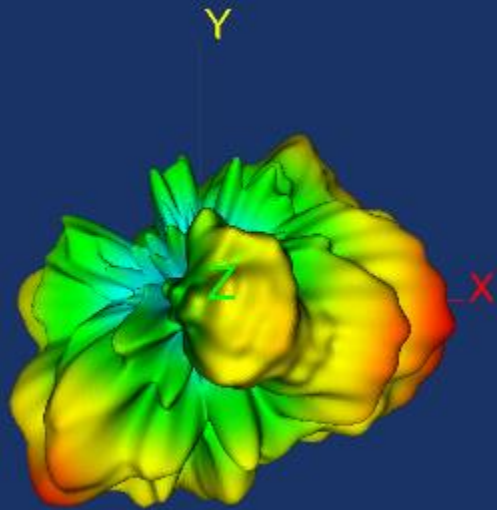
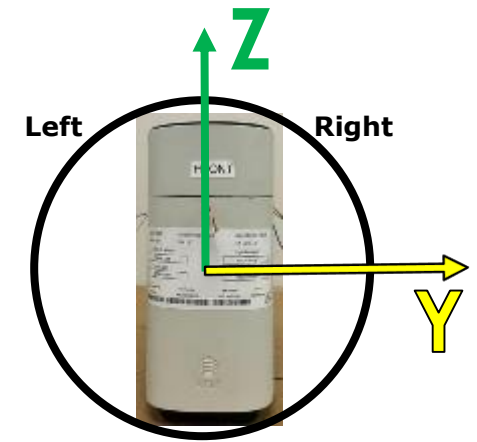
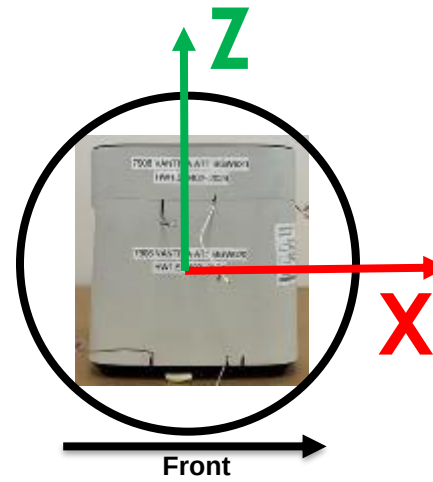
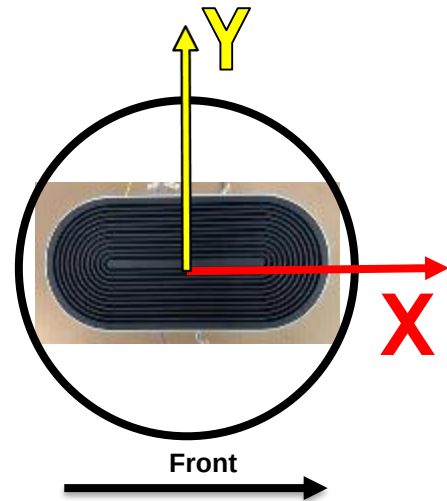


Front-to-Back

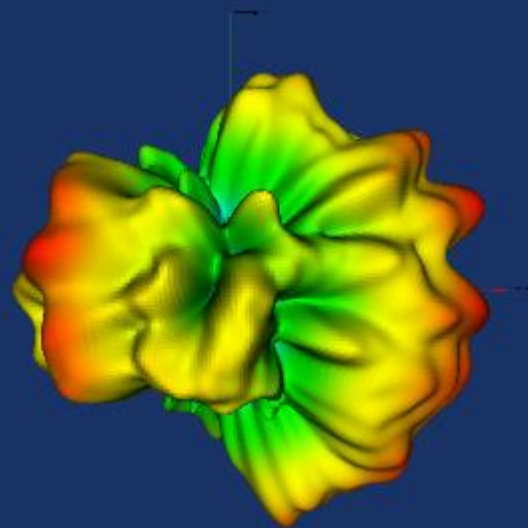


Side-to-Side

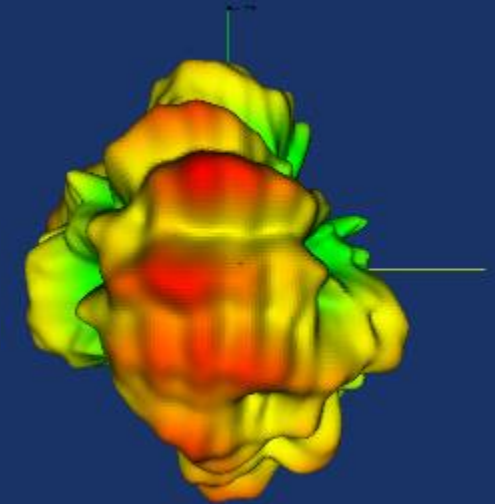
3D Gain Plot – DFS 6 GHz Antenna – 6.5 GHz



Azimuth

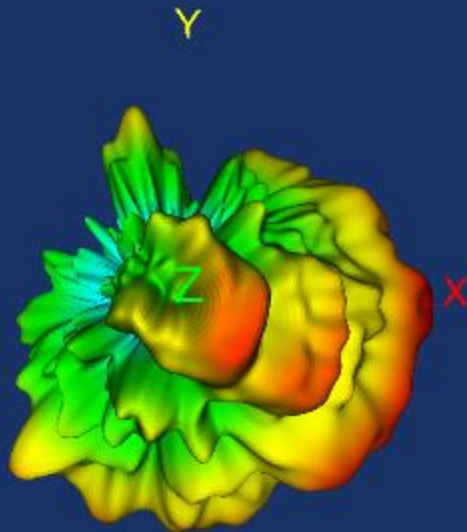
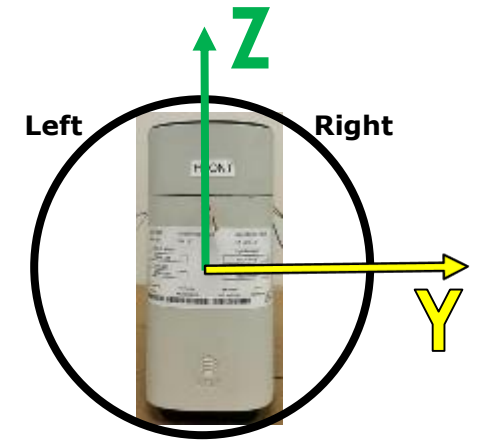
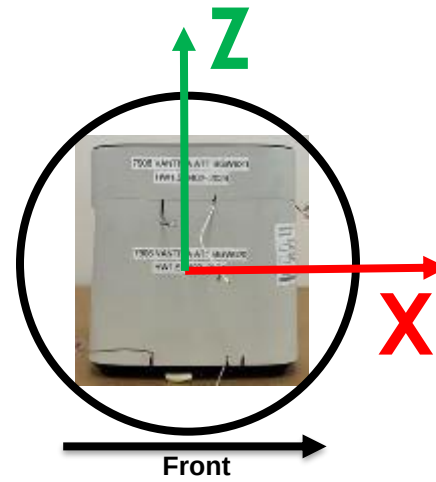
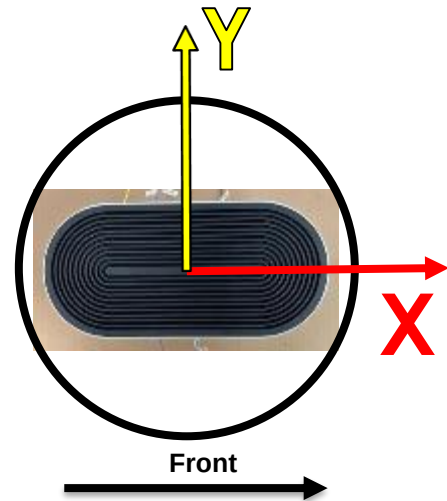


Front-to-Back

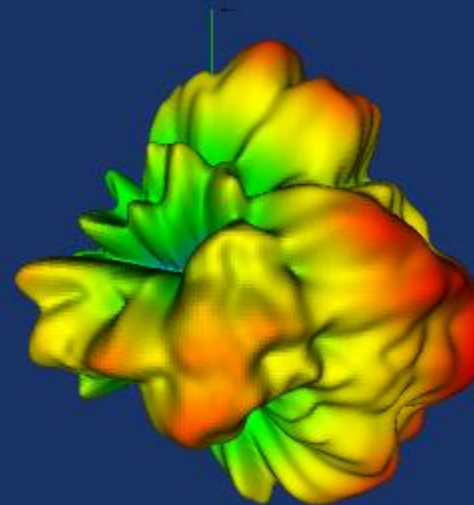


Side-to-Side

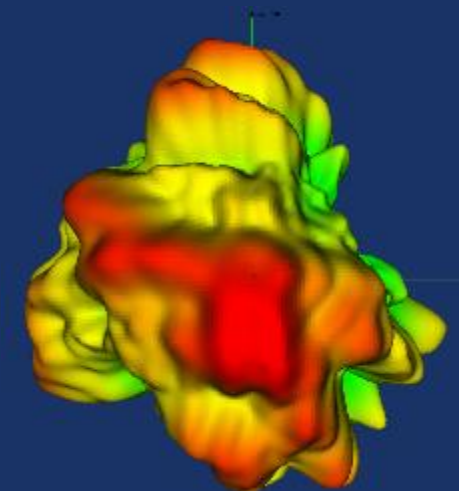
3D Gain Plot – DFS 6 GHz Antenna – 7.125 GHz



Azimuth

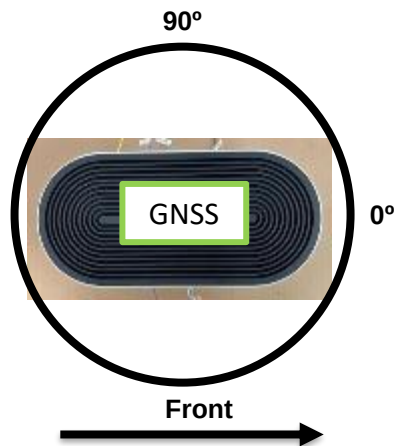


Front-to-Back

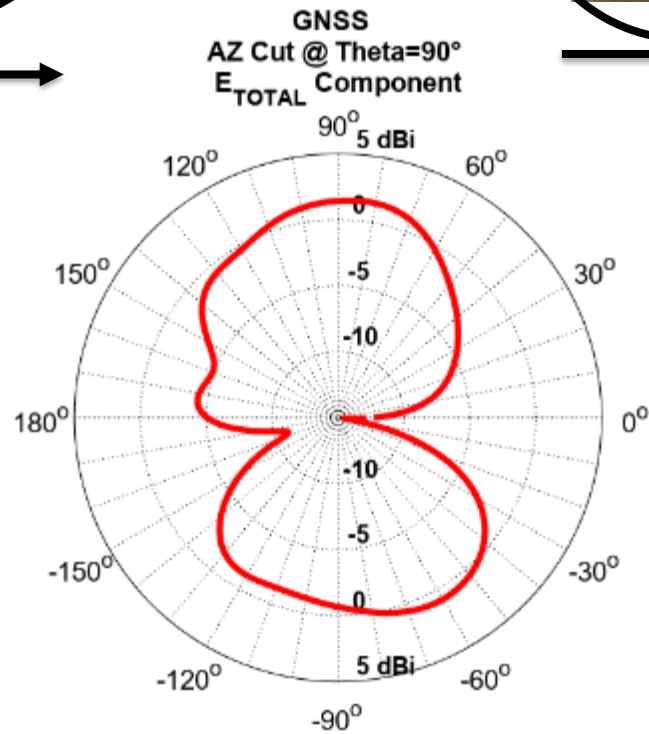
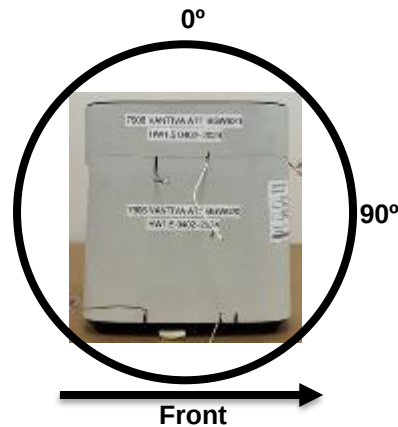


Side-to-Side

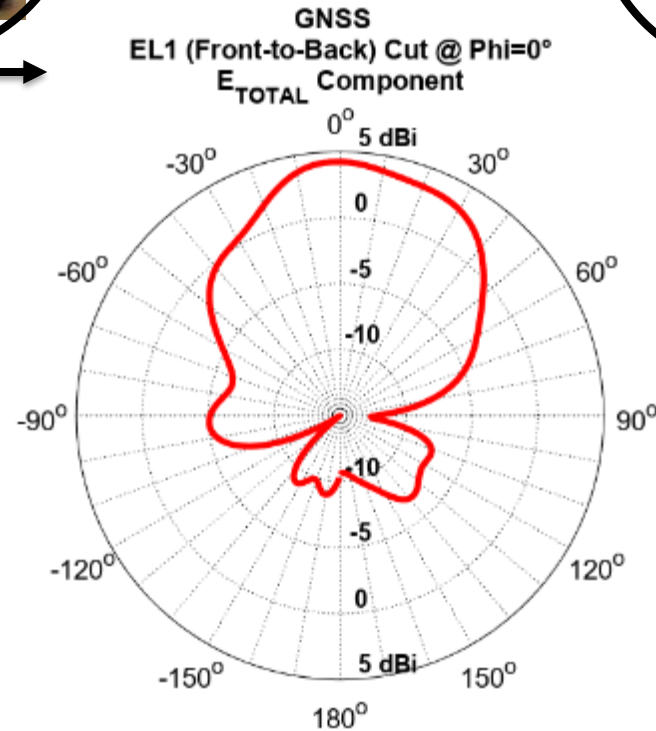
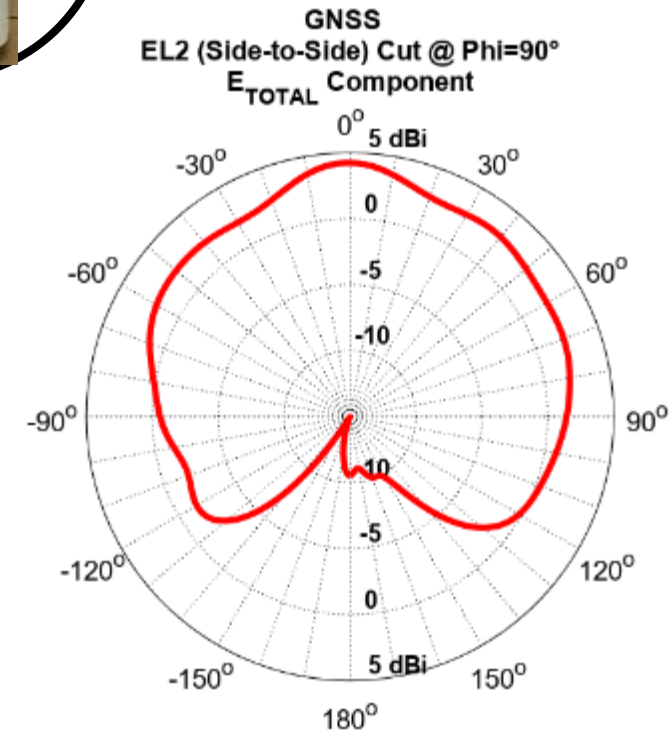
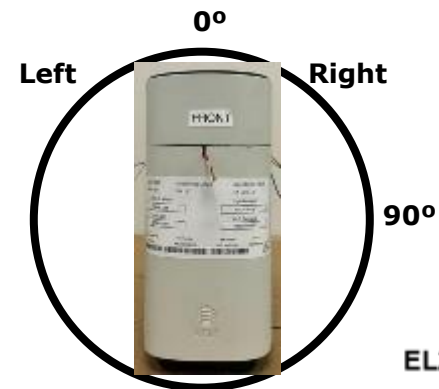
GNSS Antenna Power Sum Gain Patterns



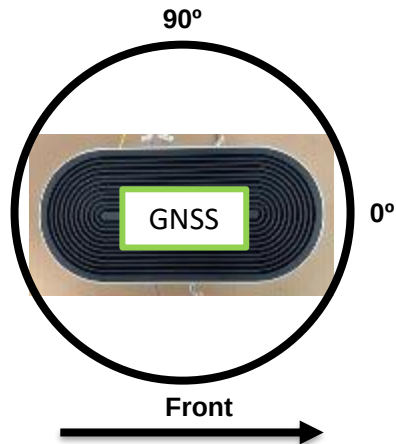
1575 MHz

Azimuth Cut ($\theta = 90^\circ$)

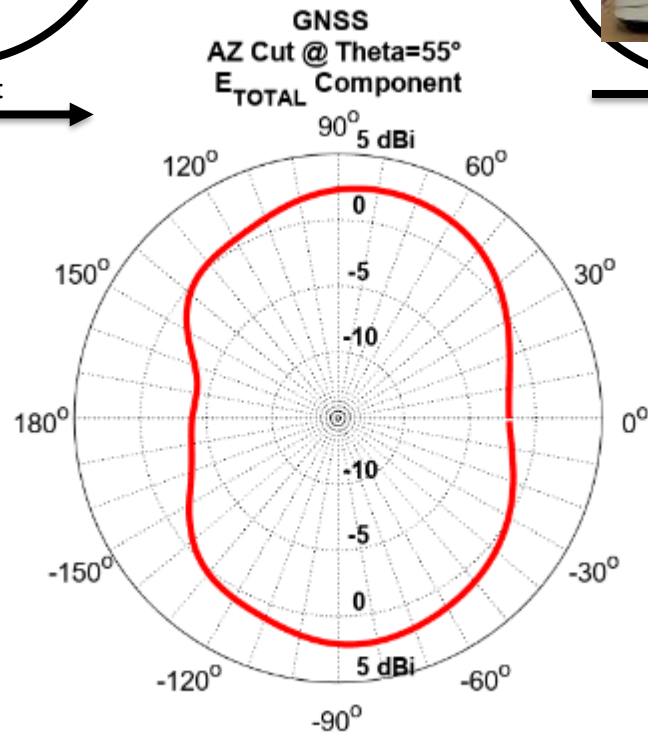
1575 MHz

Elevation
(Front to Back) CutElevation
(Side to Side) Cut

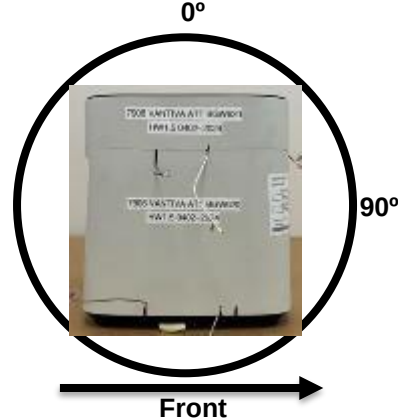
GNSS Antenna Power Sum Gain Patterns



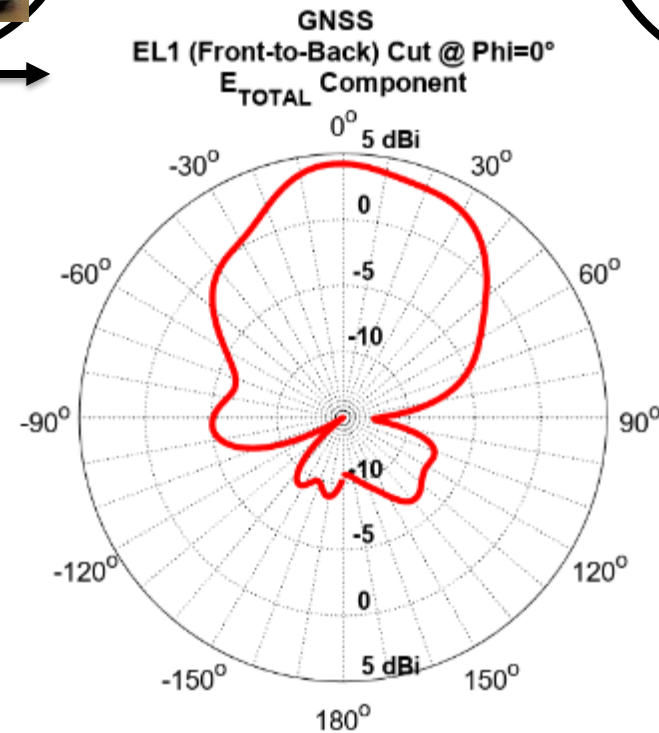
1575 MHz



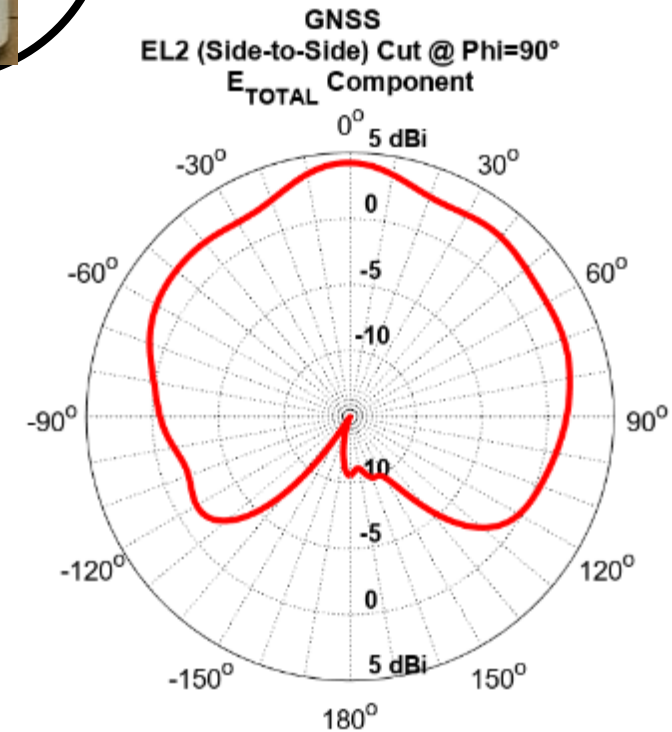
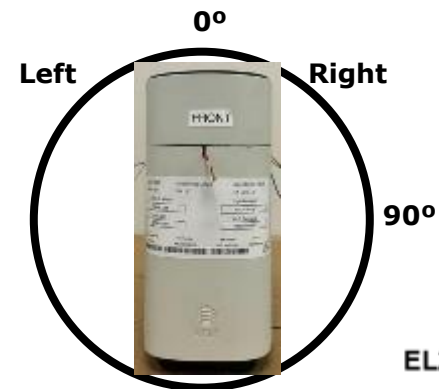
Azimuth Cut ($\theta = 35^\circ$)
GPS inclination angle is 55°



1575 MHz

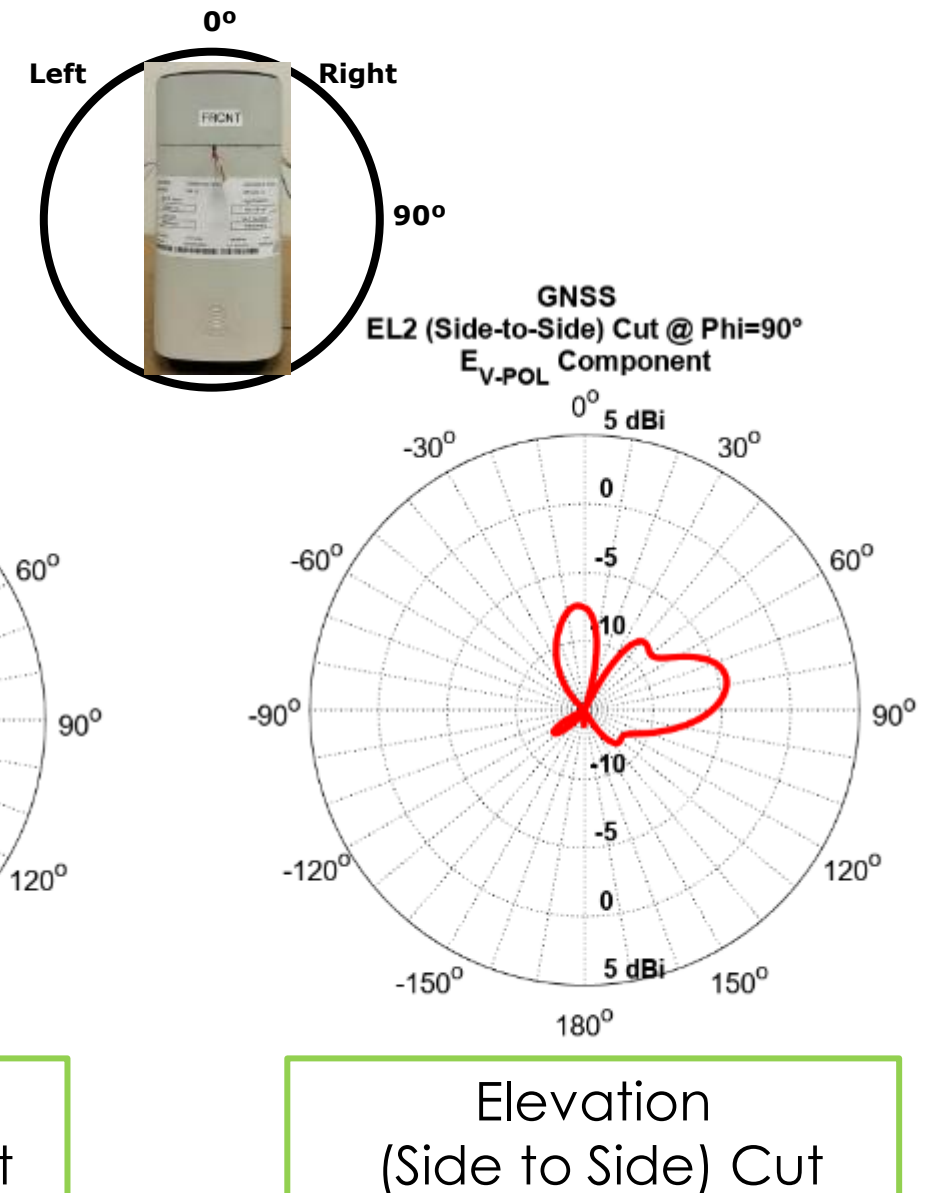
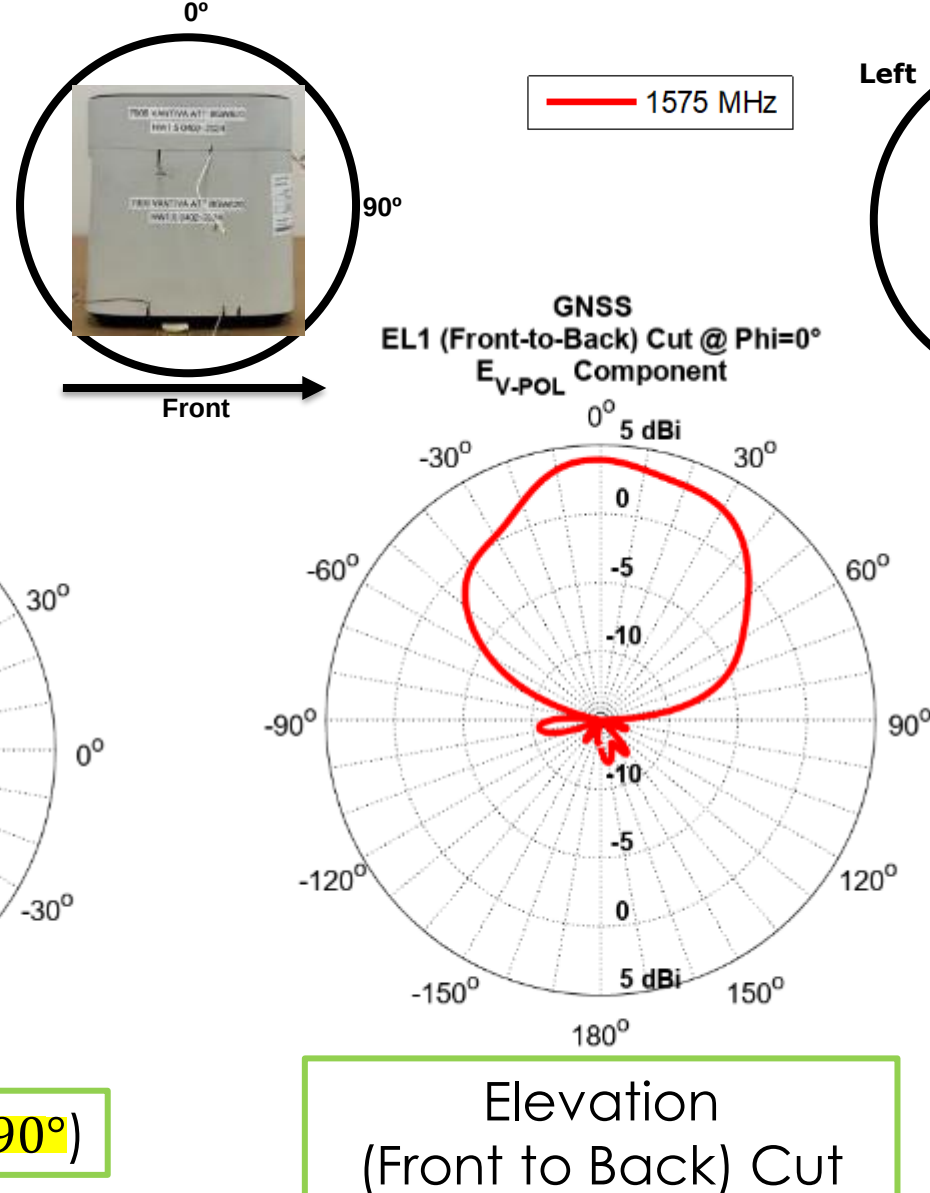
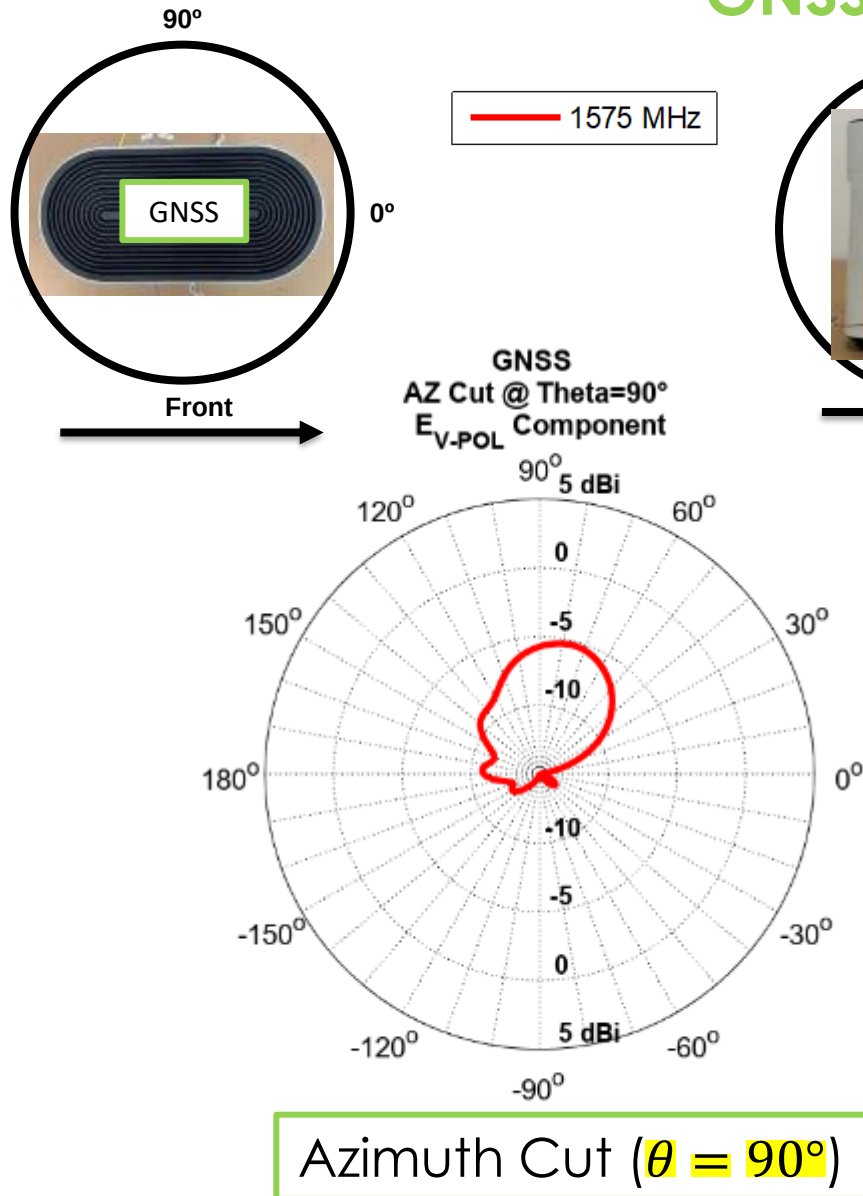


Elevation
(Front to Back) Cut

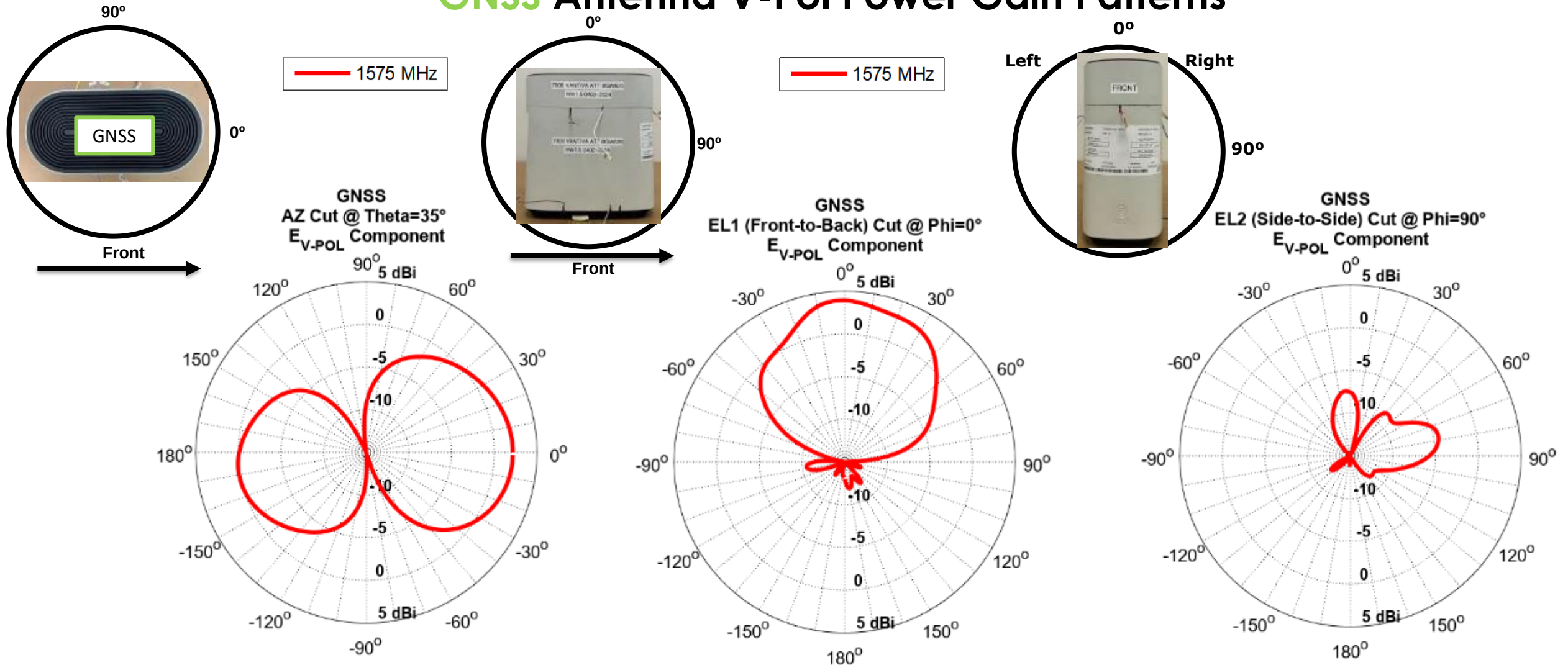


Elevation
(Side to Side) Cut

GNSS Antenna V-Pol Power Gain Patterns



GNSS Antenna V-Pol Power Gain Patterns

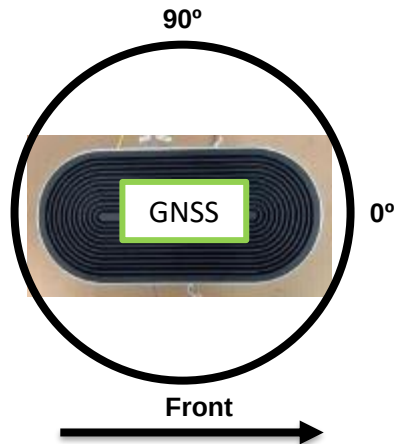


Azimuth Cut ($\theta = 35^\circ$)
GPS inclination angle is 55°

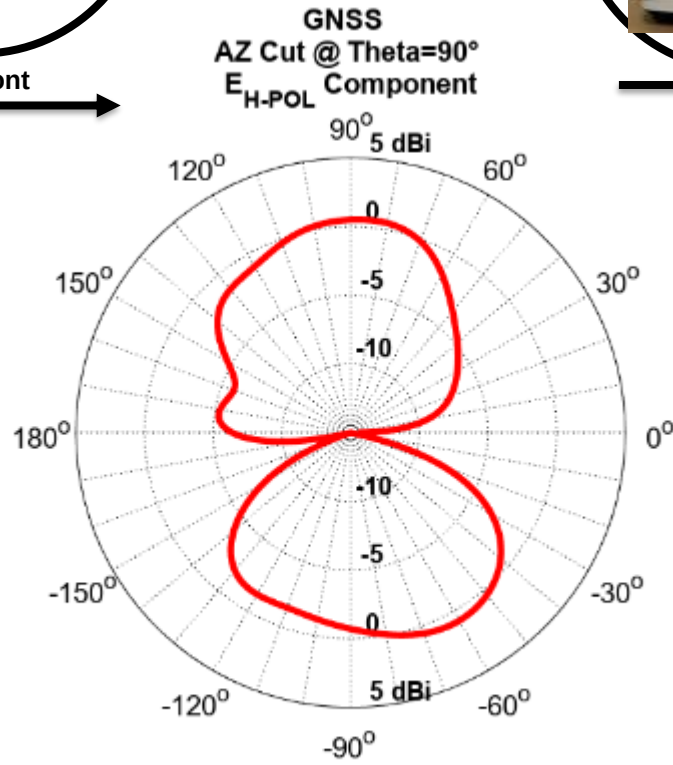
Elevation
(Front to Back) Cut

Elevation
(Side to Side) Cut

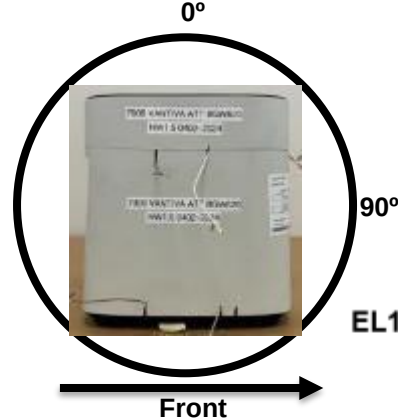
GNSS Antenna H-Pol Power Gain Patterns



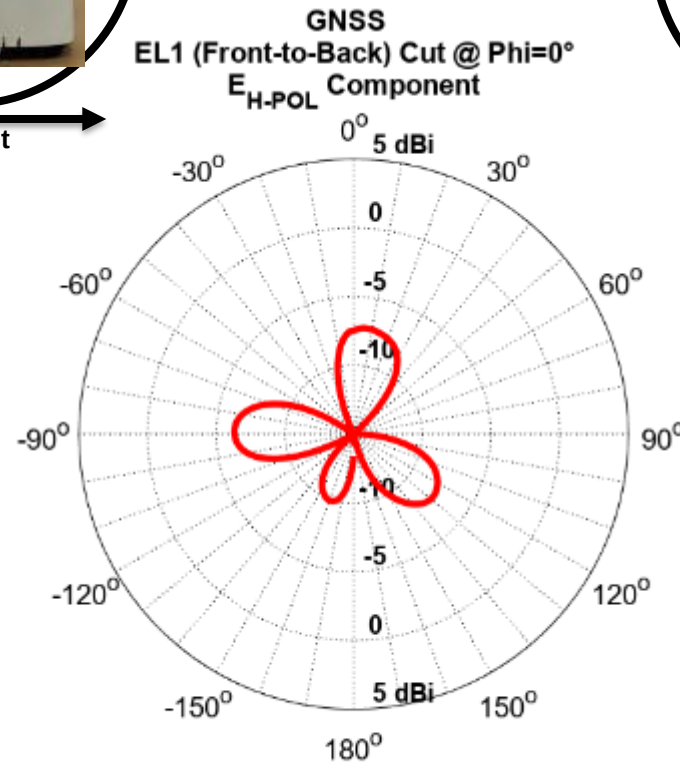
1575 MHz



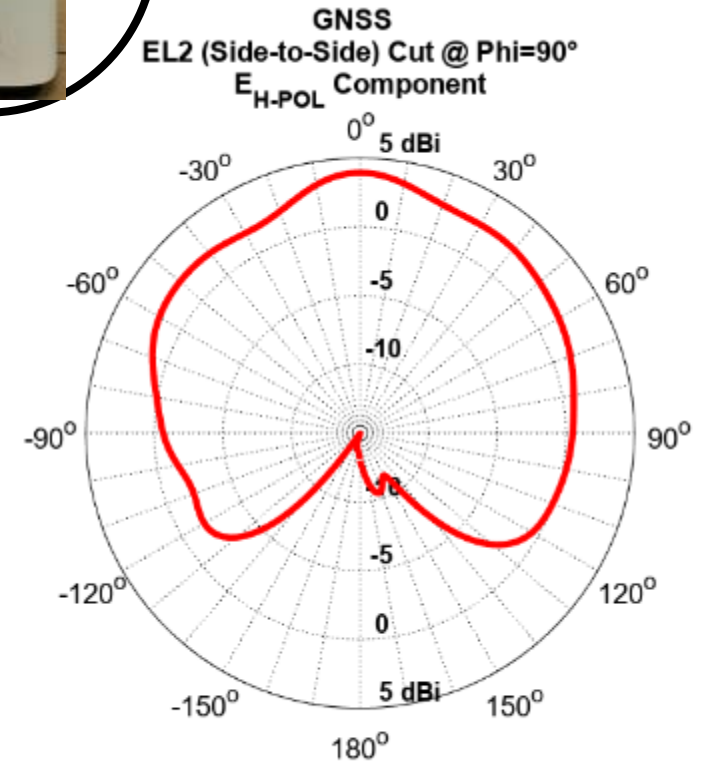
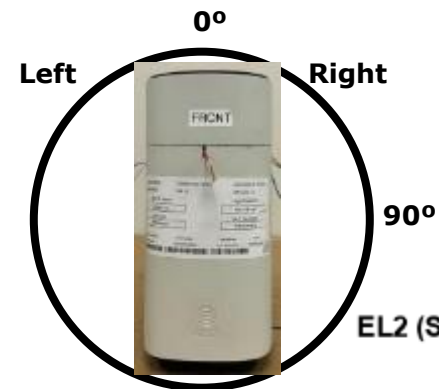
Azimuth Cut ($\theta = 90^\circ$)



1575 MHz

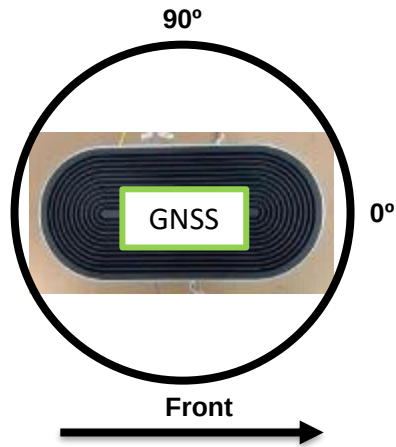


Elevation
(Front to Back) Cut



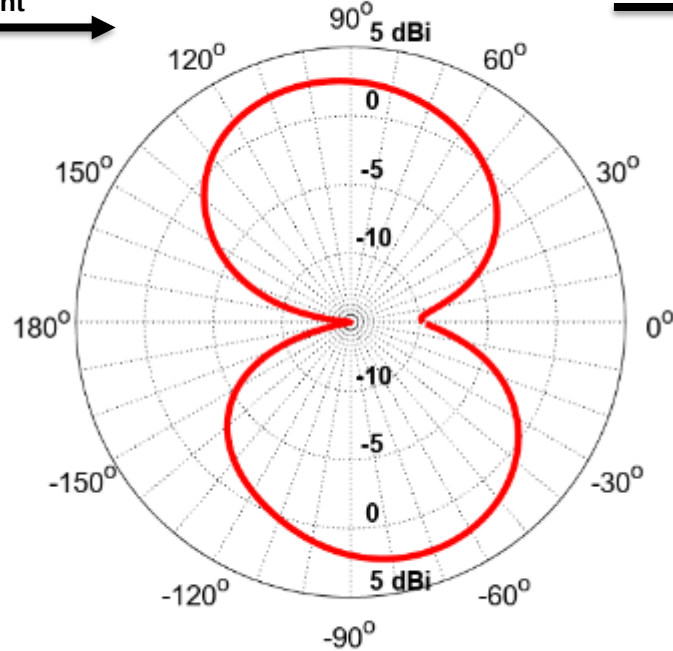
Elevation
(Side to Side) Cut

GNSS Antenna H-Pol Power Gain Patterns

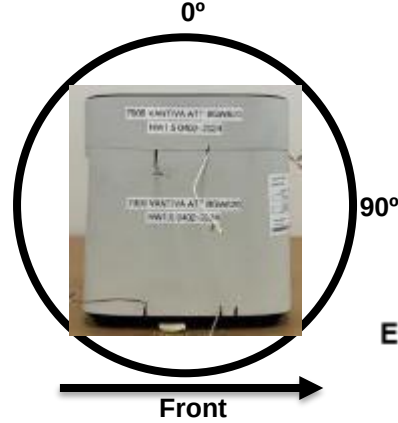


1575 MHz

GNSS
AZ Cut @ $\theta = 35^\circ$
 E_{H-POL} Component

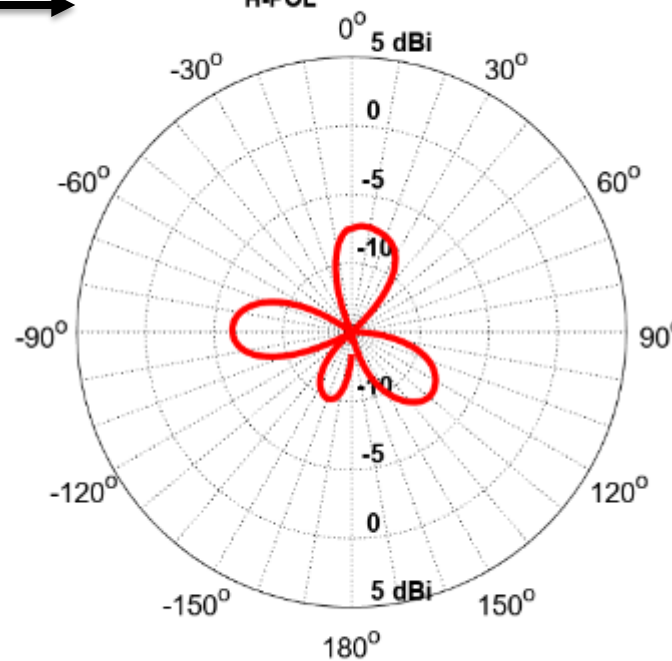


Azimuth Cut ($\theta = 35^\circ$)
GPS inclination angle is 55°

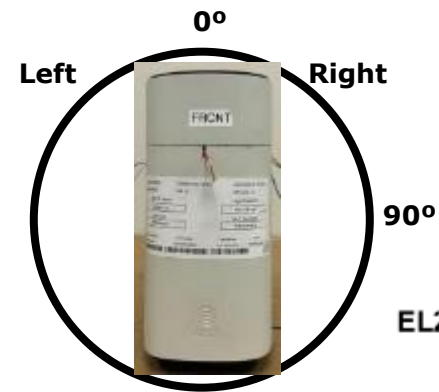


1575 MHz

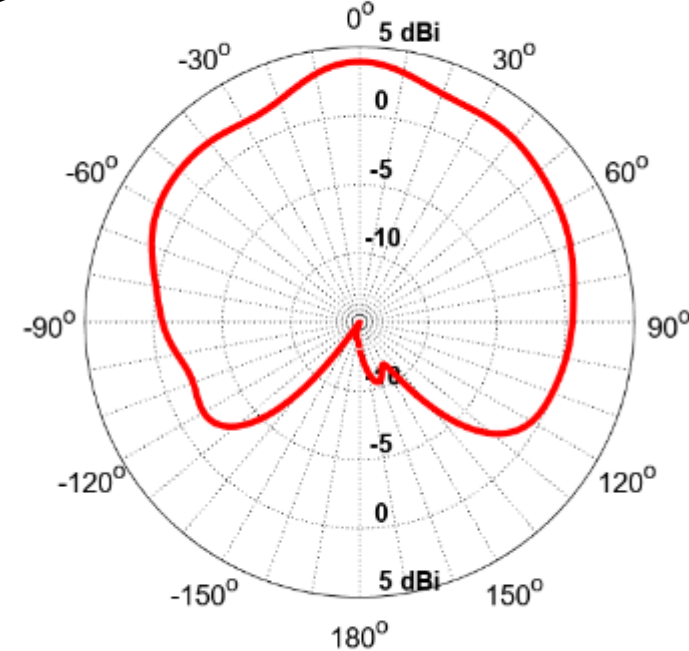
GNSS
EL1 (Front-to-Back) Cut @ $\Phi = 0^\circ$
 E_{H-POL} Component



Elevation
(Front to Back) Cut



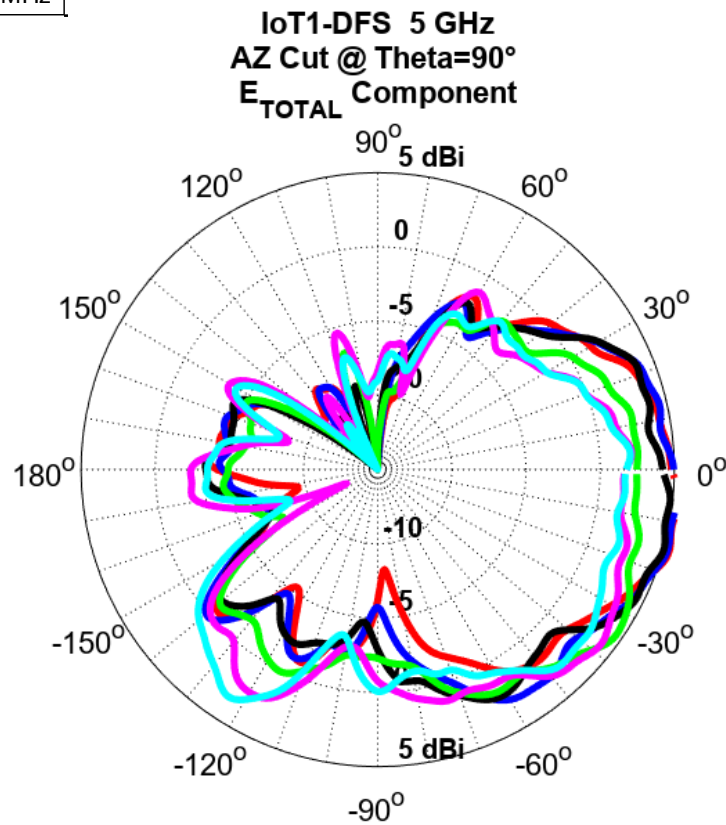
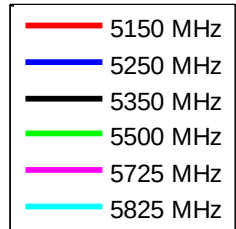
GNSS
EL2 (Side-to-Side) Cut @ $\Phi = 90^\circ$
 E_{H-POL} Component



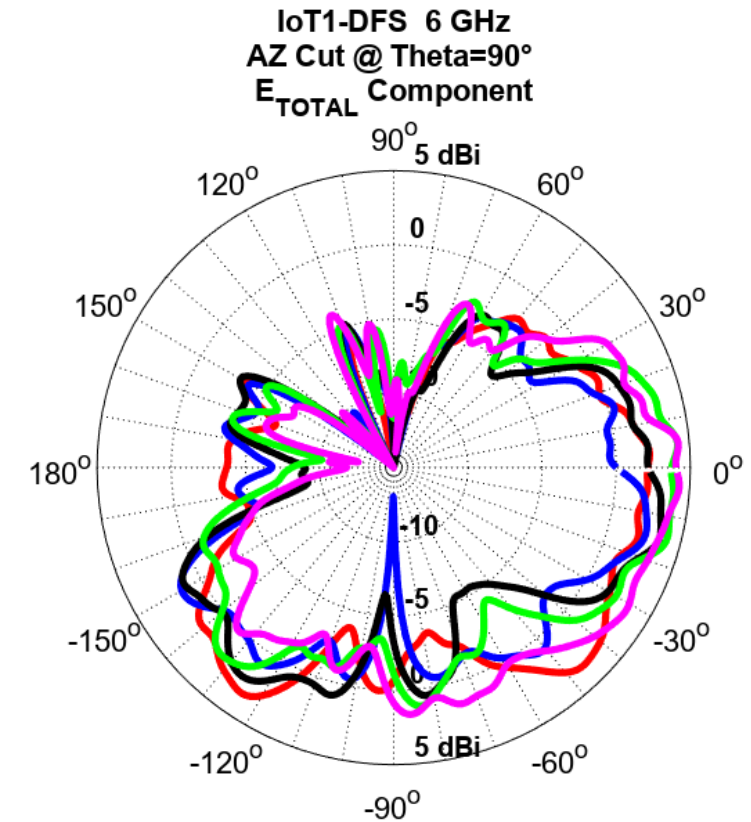
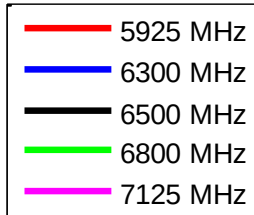
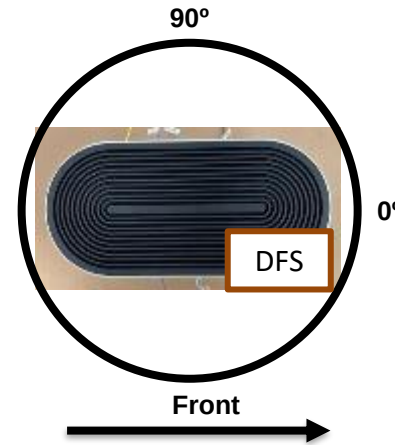
Elevation
(Side to Side) Cut

Azimuth Cut - Power Sum

DFS Antenna

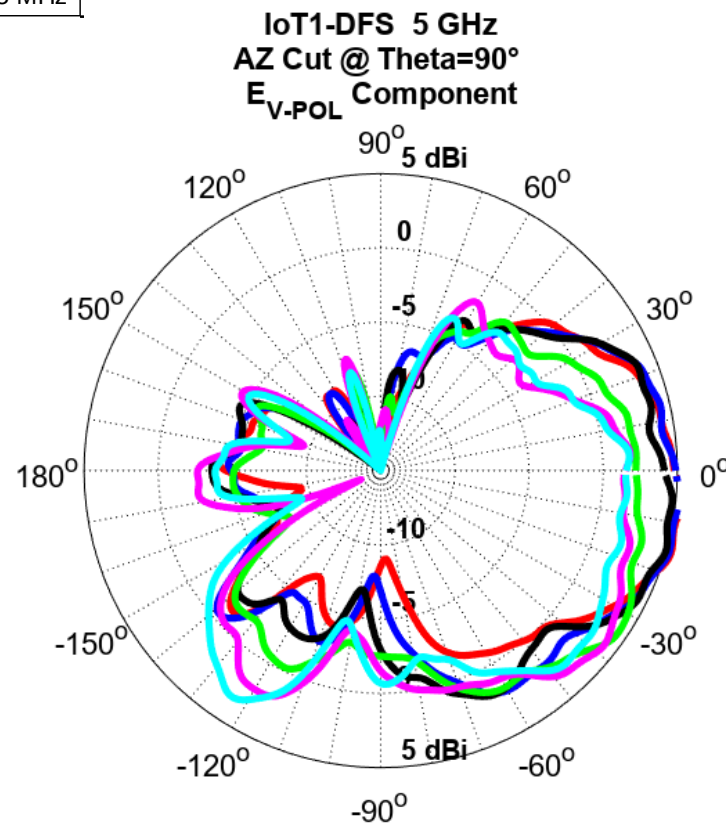
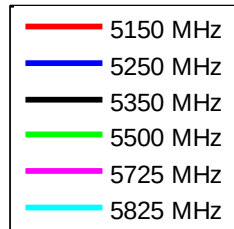


DFS-5 GHz

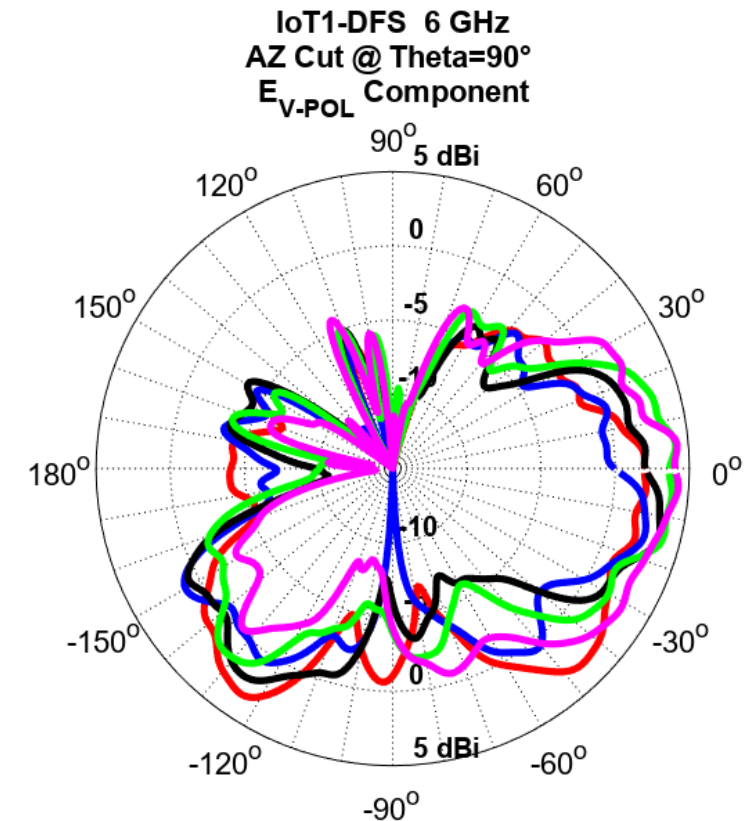
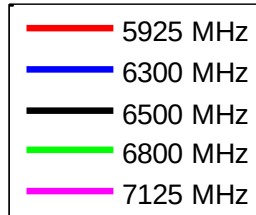
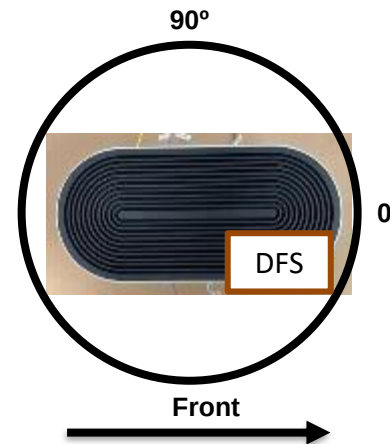


DFS-6 GHz

Azimuth Cut – V-Pol Power DFS Antenna



DFS-5 GHz

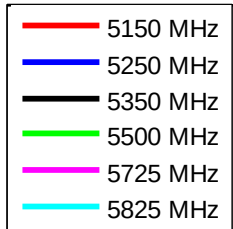


DFS-6 GHz

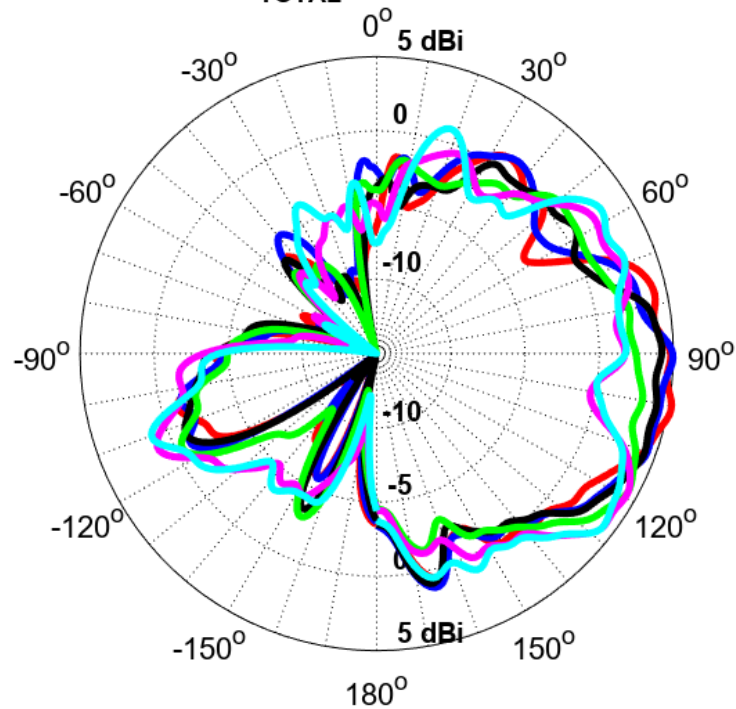
DFS Antenna



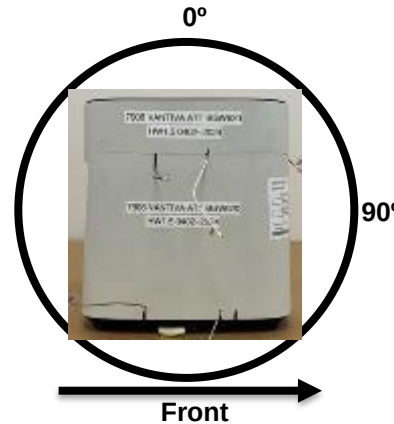
Elevation (Front to Back) Cut - Power Sum DFS Antenna



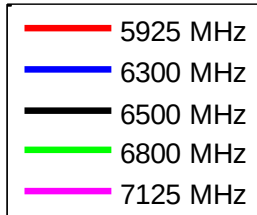
IoT1-DFS 5 GHz
EL1 (Front-to-Back) Cut @ $\Phi=0^\circ$
 E_{TOTAL} Component



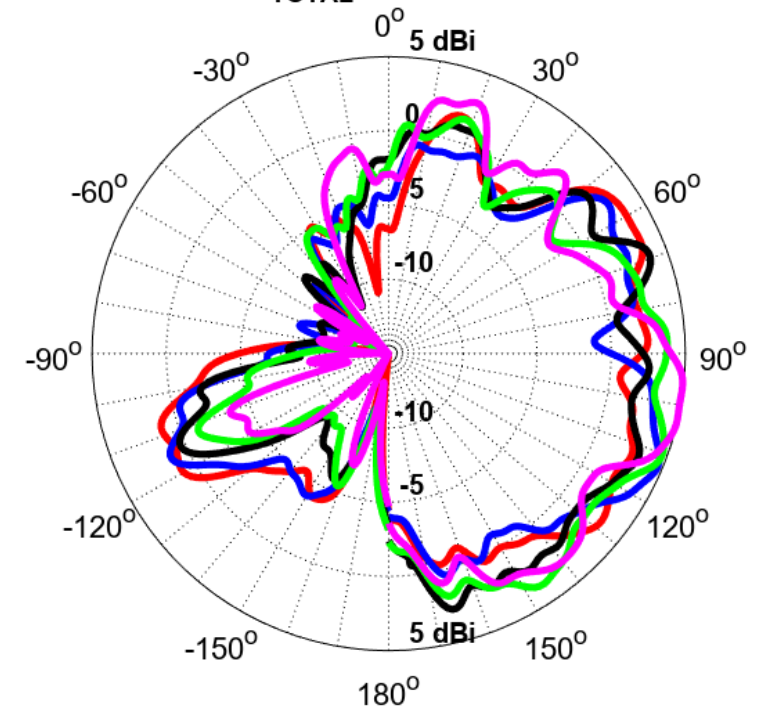
DFS-5 GHz



DFS



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



DFS-6 GHz