GALTRONICS

WHEN CONNECTIONS COUNT

Adtran Mount Stuart WiFi 7 Antenna Performance Report

Galtronics Project: 7897

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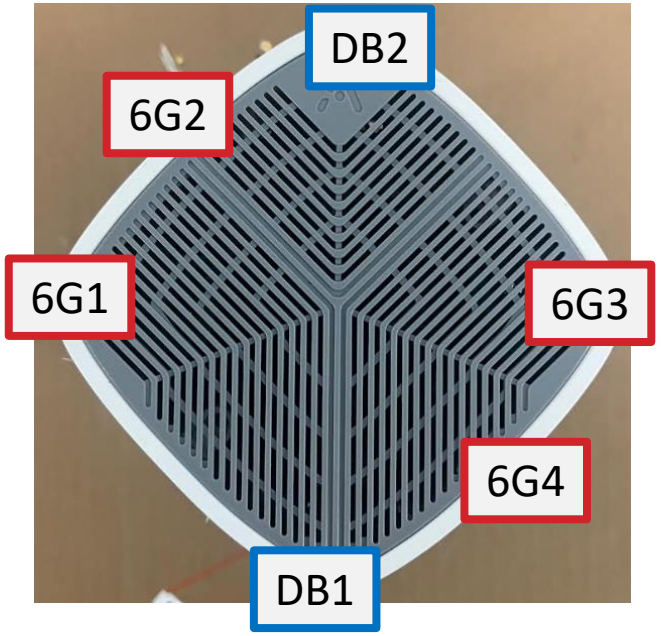
Feb 05, 2024

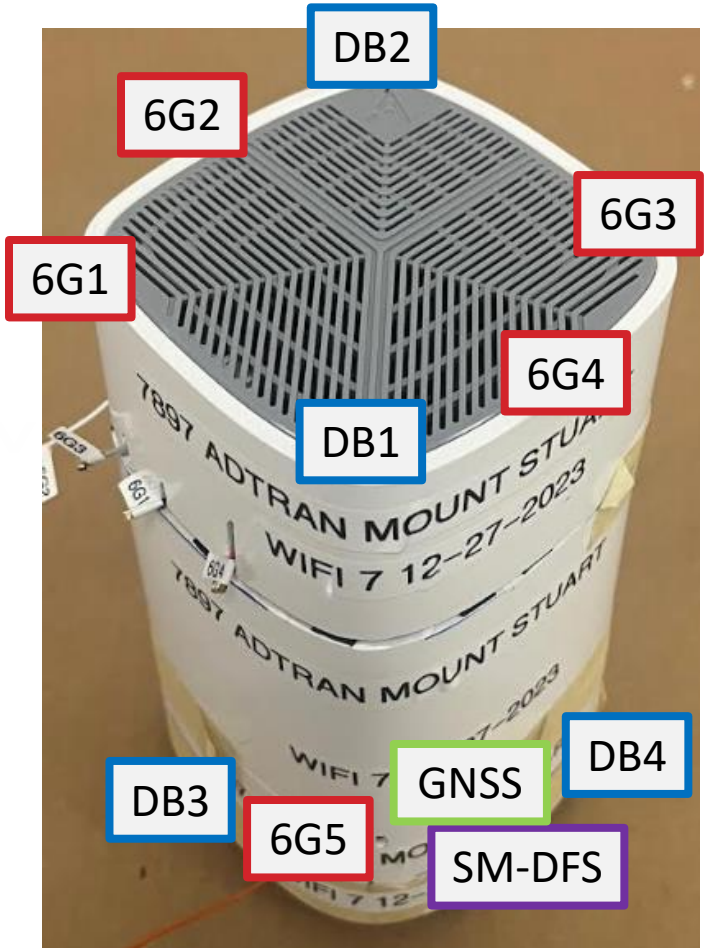
Introduction

- Galtronics developed an antenna solution for Adtran Mount Stuart WiFi 7
- Galtronics received the production unit from customer
- There are 11 antennas
  - Five PCB Dual Band antennas (DB1, DB2, DB3, DB4 and SM-DFS)
  - Five PCB 6 GHz antennas (6G1, 6G2, 6G3, 6G4 and 6G5) and One PCB GNSS antennas
- Tuned DB1, DB2, 6G5, DB4. SM-DFS is a new antenna.
- SM-DFS and DB4 antenna are new position and tilted based on customer request.
- 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 SM is 2.4 GHz - 2.5 GHz.
- The operation Frequency of DFS is 5.15 GHz - 5.825 GHz.
- The operation Frequency of GNSS is at 1.575 GHz.
- Measured return loss, isolation, peak gain, efficiency, composite gain and gain pattern of the antennas

Antenna Location



Front



Z-direction

Cable lengths and Antenna Orientation

Antenna	Cable Length	Orientation	Cable Color
GNSS	120 mm	Mix	Pink
DB1	160 mm	H	Blue
DB2	120 mm	H	Brown
DB3	115 mm	V	Yellow
DB4	208.4 mm	V -35°	Green
SM-DFS	226 mm	V +35°	Violet
6G1	122 mm	H-Pol Omni	Black
6G2	82 mm	V	White
6G3	170 mm	H-Pol Omni	Charcoal
6G4	112 mm	V	Red
6G5	124 mm	V	Orange
H = Horizontal V = Vertical			

Cable lengths/colors will be updated based on cable routing/requesting

Performance Summary

Antenna	Worst Case Return Loss (dB) 1.575 GHz Band	Worst Case Return Loss (dB) 2.45 GHz Band	Worst Case Return Loss (dB) 5 GHz Band	Worst Case Return Loss (dB) 6 GHz Band	Mutual Isolation (dB) 1.575 GHz Band	Mutual Isolation (dB) 2.45 GHz Band					Mutual Isolation (dB) 5 GHz Band					Mutual Isolation (dB) 6 GHz Band				
					GNSS	DB1	DB2	DB3	DB4	SM-DFS	DB1	DB2	DB3	DB4	SM-DFS	6G1	6G2	6G3	6G4	6G5
GNSS	-24.9					-30.0	-25.6	-44.3	-21.5	-20.8	-40.1	-39.8	-39.6	-31.3	-28.2	-40.0	-38.9	-32.0	-32.6	-42.4
SM-DFS		-13.8	-14.6		-24.7	-35.8	-31.8	-22.0	-16.3		-40.0	-47.8	-29.2	-20.9		-45.0	-43.4	-41.6	-39.6	-32.1
DB1		-14.3	-17.2		-25.2											-24.0	-35.1	-29.0	-27.7	-37.5
DB2		-16.0	-18.1		-40.9	-17.1					-30.9					-29.0	-34.6	-25.5	-32.5	-44.4
DB3		-15.4	-11.8		-44.6	-34.9	-30.9				-42.2	-43.1				-35.9	-35.1	-41.7	-41.0	-21.2
DB4		-16.6	-12.7		-30.3	-29.9	-27.6	-17.1			-40.3	-41.8	-33.3			-46.3	-40.9	-34.5	-34.7	-38.9
6G1				-12.0	-41.7	-39.3	-46.6	-48.6	-59.6	-51.5	-28.4	-32.6	-42.2	-43.7	-54.1					
6G2				-16.5	-44.8	-40.0	-40.7	-36.4	-39.9	-47.6	-31.0	-37.5	-32.4	-41.1	-30.5	-28.0				
6G3				-15.4	-38.9	-44.7	-47.9	-60.6	-63.1	-59.4	-28.0	-24.0	-37.7	-35.9	-37.6	-32.5	-36.3			
6G4				-17.0	-38.9	-24.1	-33.2	-39.9	-38.3	-42.1	-31.2	-35.0	-39.9	-30.8	-40.0	-32.9	-31.3	-28.3		
6G5				-13.6	-35.8	-33.8	-32.0	-23.4	-33.6	-30.9	-38.2	-44.8	-20.3	-39.1	-33.4	-34.8	-30.0	-44.0	-41.0	

Antenna	Average Efficiency 1.575 GHz Band (%)	Average Efficiency 2.45 GHz Band (%)	Average Efficiency 5 GHz Band (%)	Average Efficiency 6 GHz Band (%)	Highest Peak Gain 1.575 GHz Band (dBi)	Highest Peak Gain 2.45 GHz Band (dBi)	Highest Peak Gain 5 GHz Band (dBi)	Highest Peak Gain 6 GHz Band (dBi)
GNSS	64.9				3.9			
SM-DFS		60.7	62.9			4.1	5.9	
DB1		67.5	72.3			3.9	5.7	
DB2		70.3	72.4			4.9	5.2	
DB3		66.3	65.8			3.8	6.0	
DB4		61.6	62.5			5.0	6.5	
6G1				63.3				5.0
6G2				69.9				5.5
6G3				63.0				3.0
6G4				69.7				4.4
6G5				63.9				6.0

DB Antennas Peak Gain and Efficiency

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB1	2400	3.458	5.167	67.48 %
	2450	3.688	5.396	67.48 %
	2500	3.948	5.651	67.56 %
	Average			67.51 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB2	2400	4.920	6.342	72.09 %
	2450	4.406	5.905	70.80 %
	2500	3.943	5.609	68.14 %
	Average			70.34 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB3	2400	3.842	5.572	67.13 %
	2450	3.724	5.529	65.99 %
	2500	3.838	5.656	65.80 %
	Average			66.31 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB4	2400	4.743	6.785	62.50 %
	2450	5.006	7.138	61.20 %
	2500	3.798	5.932	61.19 %
	Average			61.63 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB1	5150	5.688	6.895	75.73 %
	5250	5.436	6.837	72.43 %
	5350	5.607	6.901	74.23 %
	5500	5.316	6.876	69.83 %
	5725	4.309	5.849	70.14 %
	5825	4.228	5.685	71.50 %
	Average			72.31 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB2	5150	4.627	5.856	75.36 %
	5250	4.420	5.844	72.05 %
	5350	4.569	6.069	70.80 %
	5500	4.864	6.312	71.64 %
	5725	5.030	6.412	72.74 %
	5825	5.170	6.611	71.77 %
	Average			72.39 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB3	5150	3.430	5.107	67.97 %
	5250	4.597	6.464	65.06 %
	5350	5.481	7.309	65.64 %
	5500	6.018	7.889	65.00 %
	5725	4.561	6.406	65.39 %
	5825	4.796	6.601	66.00 %
	Average			65.84 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
DB4	5150	6.346	8.173	65.67 %
	5250	6.018	7.897	64.88 %
	5350	6.510	8.521	62.93 %
	5500	5.997	8.240	59.66 %
	5725	5.884	7.998	61.46 %
	5825	5.982	8.165	60.49 %
	Average			62.52 %

GNSS and SM-DFS Antennas Peak Gain and Efficiency

GNSS	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	1575	3.940	5.818	64.89 %

SM	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	2400	4.006	6.186	60.53 %
	2450	4.063	6.196	61.19 %
	2500	4.092	6.289	60.30 %
	Average			60.67 %

DFS	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
	5150	5.511	7.298	66.27 %
	5250	5.909	8.046	61.14 %
	5350	5.704	7.627	64.24 %
	5500	4.908	7.021	61.48 %
	5725	5.159	7.227	62.11 %
	5825	5.526	7.605	61.96 %
	Average			62.87 %

6 GHz Antennas Peak Gain and Efficiency

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
6G1	5925	3.633	5.409	66.44 %
	6300	3.365	5.279	64.36 %
	6500	3.270	5.248	63.41 %
	6800	5.028	7.144	61.44 %
	7125	3.521	5.668	61.00 %
	Average			63.33 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
6G2	5925	5.509	6.977	71.31 %
	6300	4.862	6.474	68.98 %
	6500	4.485	6.054	69.68 %
	6800	4.791	6.277	71.01 %
	7125	4.287	5.943	68.30 %
	Average			69.86 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
6G3	5925	2.745	4.712	63.59 %
	6300	2.708	4.668	63.68 %
	6500	2.990	4.975	63.31 %
	6800	2.441	4.428	63.29 %
	7125	2.648	4.782	61.17 %
	Average			63.01 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
6G4	5925	4.363	5.843	71.12 %
	6300	3.704	5.352	68.42 %
	6500	3.851	5.413	69.78 %
	6800	3.334	4.956	68.84 %
	7125	3.701	5.234	70.27 %
	Average			69.69 %

	Freq (MHz)	Peak Gain (dBi)	Directivity (dBi)	Efficiency
6G5	5925	5.989	7.883	64.67 %
	6300	4.196	6.132	64.03 %
	6500	4.635	6.479	65.40 %
	6800	4.055	5.988	64.08 %
	7125	4.055	6.185	61.23 %
	Average			63.88 %

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	2	349	2.46	4.89	-8.81	-6.70	5.82
2450	13	357	0.40	4.13	-3.76	-5.59	5.64
2500	21	358	1.36	3.53	-2.81	-5.32	5.88

Frequency (MHz)	Degree		Gain (dBi)				Correlated Gain (dBi)-V-Pol
	Theta	Phi	DB1	DB2	DB3	DB4	
2400	0	75	2.60	4.83	-9.96	-6.85	5.72
2450	11	69	1.62	3.98	-10.19	-5.85	5.12
2500	6	71	1.60	3.30	-7.95	-5.90	5.03

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	1	346	2.57	4.89	-9.47	-6.77	1.15
2450	13	354	0.45	4.18	-3.91	-5.79	0.41
2500	21	356	1.35	3.58	-2.92	-5.33	0.46

Frequency (MHz)	Degree		Gain (dBi)				UnCorrelated Gain (dBi)-V-Pol
	Theta	Phi	DB1	DB2	DB3	DB4	
2400	0	75	2.60	4.83	-9.96	-6.85	1.11
2450	11	69	1.62	3.98	-10.19	-5.85	0.32
2500	7	70	1.48	3.38	-8.57	-5.48	0.01

DB 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	9	339	4.13	2.57	-9.20	-3.96	5.88
5250	7	346	3.96	2.15	-10.09	-4.91	5.44
5350	8	348	3.47	1.65	-8.76	-8.75	4.69
5500	7	352	2.62	2.80	-9.52	-11.73	4.42
5725	31	162	-0.60	4.37	-7.11	-5.89	4.95
5825	30	189	0.84	4.58	-12.92	-8.69	4.58

Frequency (MHz)	Degree		Gain (dBi)				Correlated Gain (dBi)-V-Pol
	Theta	Phi	DB1	DB2	DB3	DB4	
5150	17	74	-0.26	3.21	-4.01	-1.51	5.77
5250	20	75	-0.52	3.15	-4.96	-2.02	5.43
5350	20	75	0.11	3.15	-5.40	-3.53	5.23
5500	20	75	1.24	3.53	-6.01	-4.51	5.46
5725	21	71	0.75	3.19	-9.24	-5.31	4.67
5825	26	271	2.16	1.67	-3.33	-15.26	4.48

DB 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	9	347	4.38	2.69	-10.12	-5.03	0.98
5250	8	350	4.28	2.03	-10.04	-5.85	0.64
5350	8	351	3.50	1.67	-8.77	-9.05	-0.04
5500	7	355	2.65	2.79	-9.65	-11.93	-0.09
5725	33	162	-1.14	4.65	-7.44	-5.83	0.14
5825	31	187	0.55	4.75	-13.09	-8.73	0.32

Frequency (MHz)	Degree		Gain (dBi)				UnCorrelated Gain (dBi)-V-Pol
	Theta	Phi	DB1	DB2	DB3	DB4	
5150	138	206	-15.07	-6.63	-13.04	6.23	0.51
5250	140	208	-11.66	-7.25	-17.36	5.71	0.00
5350	136	201	-16.64	-6.96	-6.54	6.32	0.73
5500	136	205	-14.76	-9.49	-4.03	5.86	0.41
5725	11	268	2.74	2.60	-13.52	-10.35	-0.19
5825	17	270	2.58	2.59	-8.29	-13.34	-0.20

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	98	188	1.71	-3.52	1.15	-7.58	4.72
6300	115	159	-0.91	0.63	-0.33	-8.11	4.43
6500	105	341	1.99	-7.46	0.31	-6.11	4.11
6800	76	347	1.30	-6.74	-0.09	-3.88	4.22
7125	48	320	1.82	-4.15	0.61	-2.62	5.27

Frequency (MHz)	Degree		Gain (dBi)				Correlated Gain (dBi)-V-Pol
	Theta	Phi	6G1	6G2	6G3	6G4	
5925	82	135	-22.58	3.58	-10.84	4.08	4.79
6300	75	306	-3.45	1.35	-11.56	2.10	4.55
6500	73	183	-9.12	3.70	-18.89	2.34	4.36
6800	64	308	-4.73	4.65	-11.68	1.16	5.32
7125	68	304	-7.03	3.83	-16.11	0.50	4.12

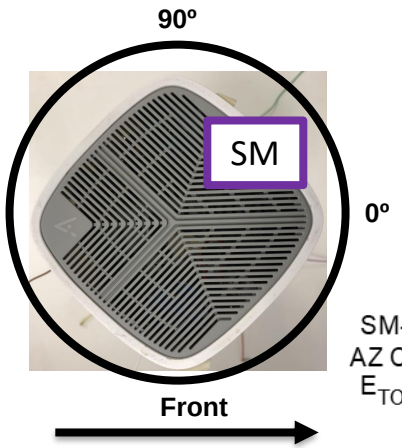
6 GHz Horizontal and Vertical Uncorrelated directional Gain

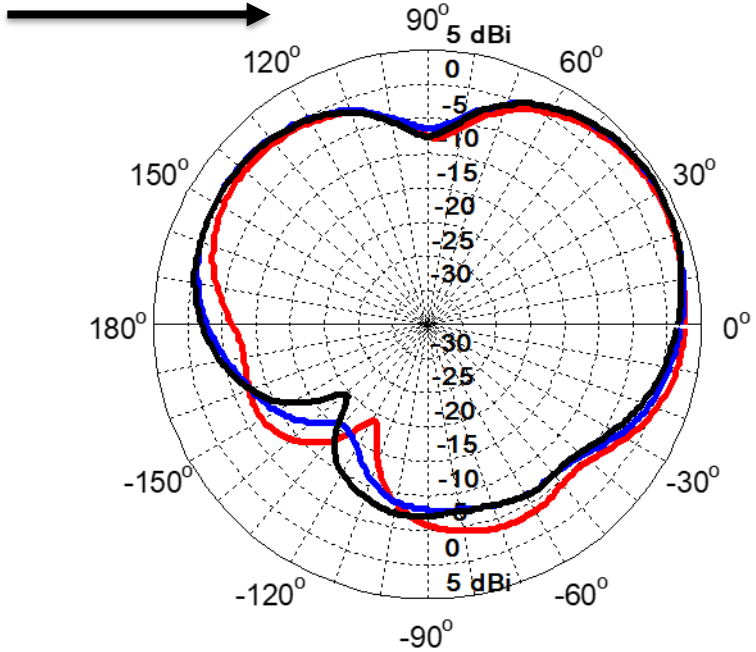
Worst Case

Frequency (MHz)	Degree		Gain (dBi)				UnCorrelated Gain (dBi) - H-Pol
	Theta	Phi	6G1	6G2	6G3	6G4	
5925	77	326	2.70	-6.91	1.46	-14.46	-0.58
6300	82	229	3.00	-8.03	1.25	-16.99	-0.58
6500	84	227	2.91	-13.74	1.62	-12.21	-0.57
6800	42	170	2.71	-10.84	-1.21	-3.86	-1.08
7125	46	317	2.51	-5.39	0.56	-3.38	-0.38

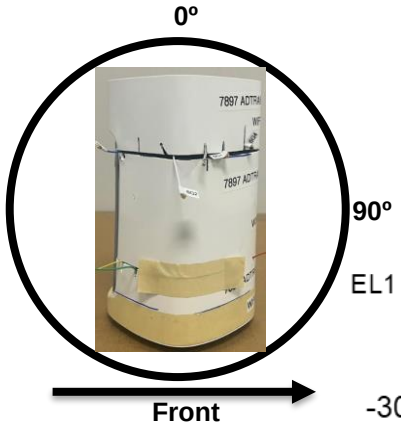
Frequency (MHz)	Degree		Gain (dBi)				UnCorrelated Gain (dBi)-V-Pol
	Theta	Phi	6G1	6G2	6G3	6G4	
5925	81	132	-31.31	3.79	-12.35	4.15	1.01
6300	79	336	-17.48	4.25	-15.72	1.33	0.06
6500	74	182	-9.55	3.55	-21.57	2.67	0.24
6800	65	306	-4.74	4.60	-13.27	1.45	0.66
7125	74	300	-8.70	3.90	-16.14	0.77	-0.21

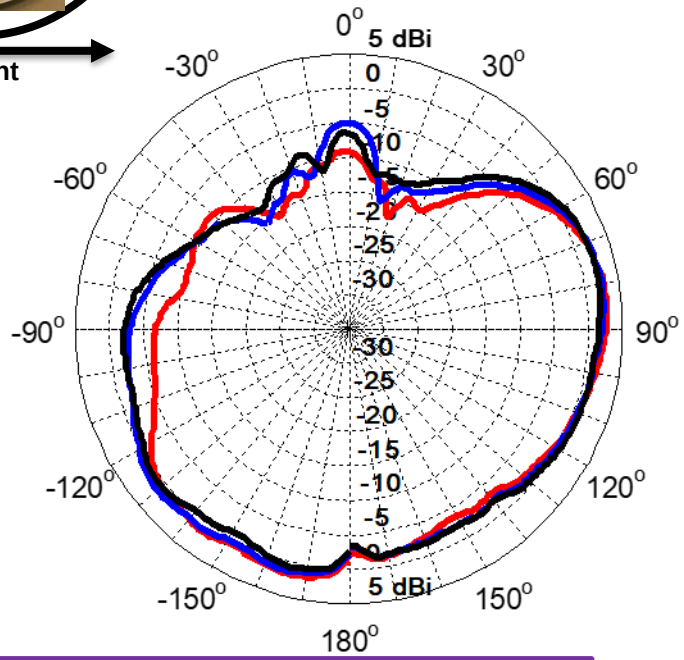
SM Antenna Power Sum Gain Patterns



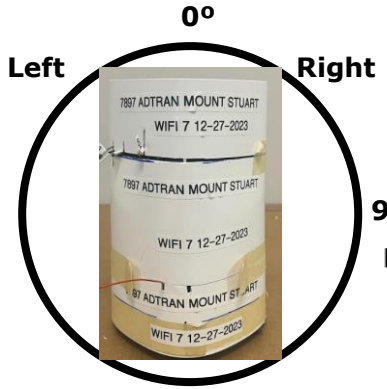


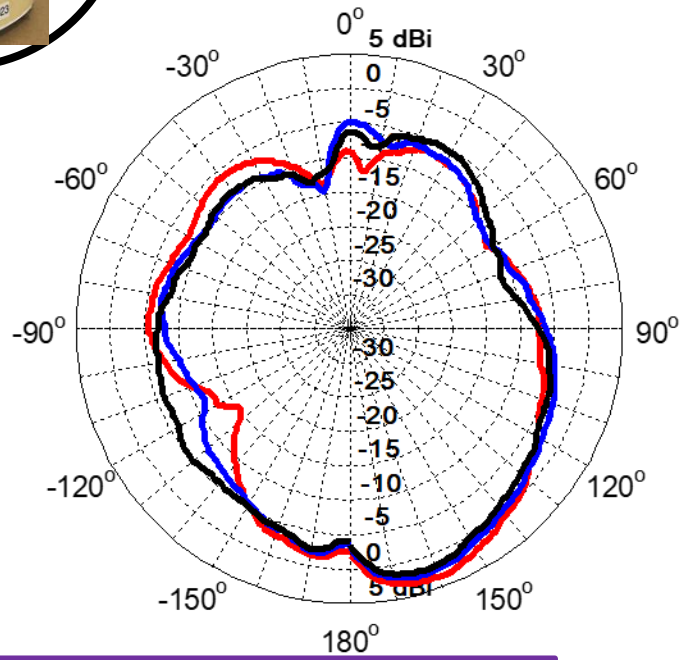
Azimuth Cut





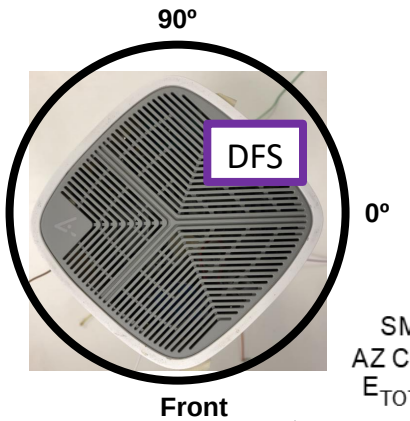
Elevation
(Front to Back) Cut

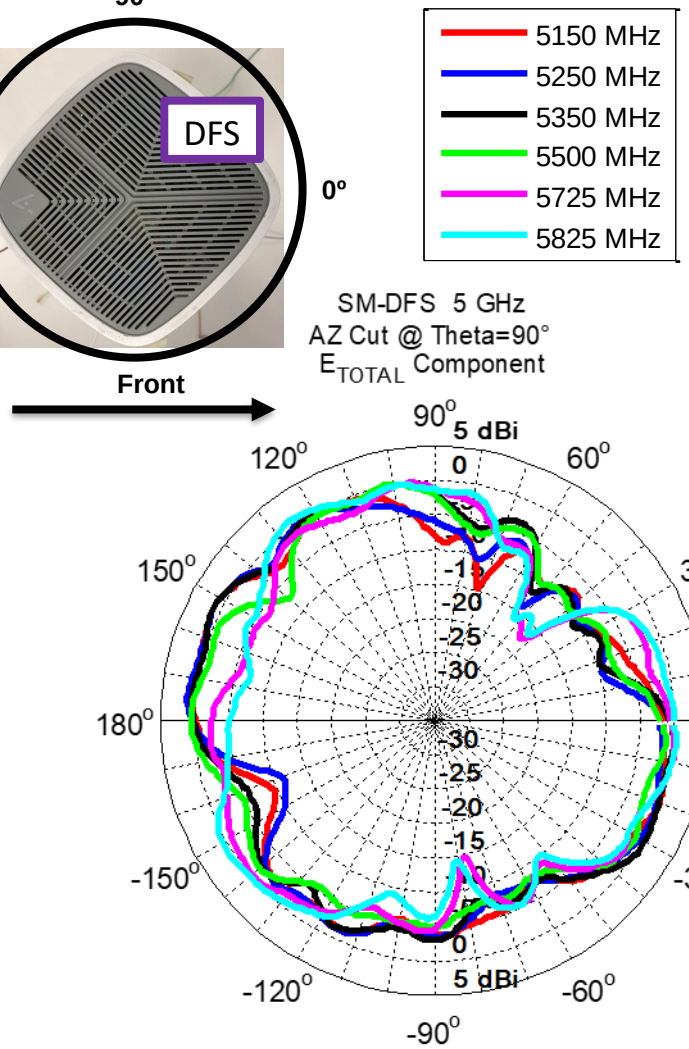




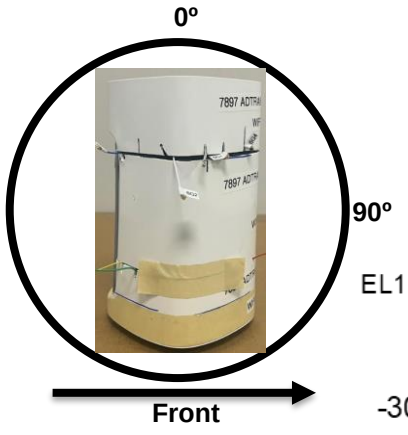
Elevation
(Side to Side) Cut

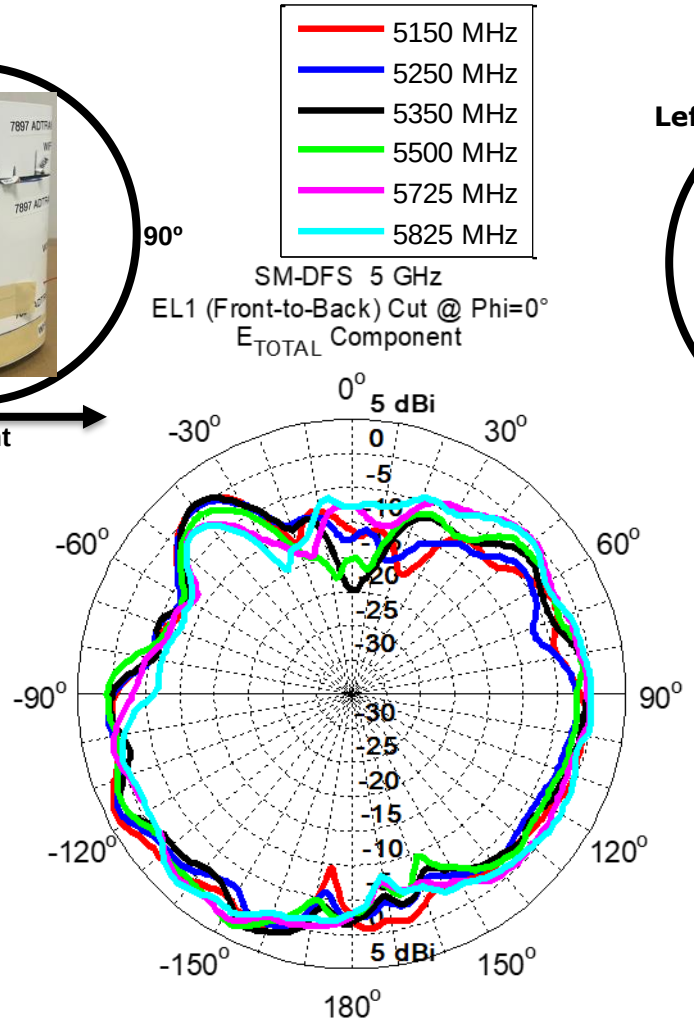
DFS Antenna Power Sum Gain Patterns



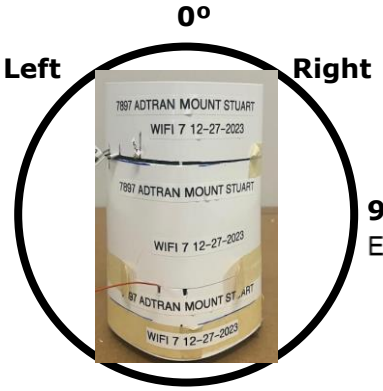


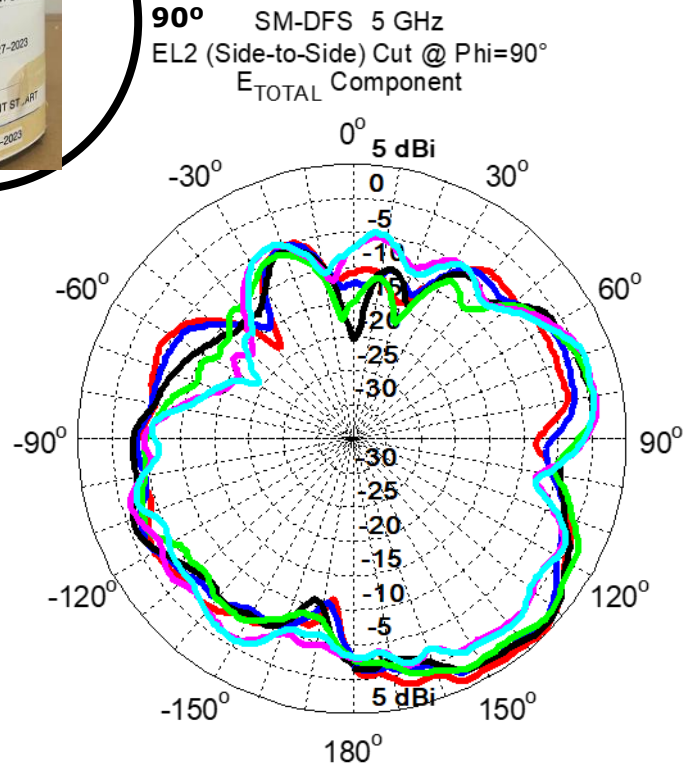
Azimuth Cut





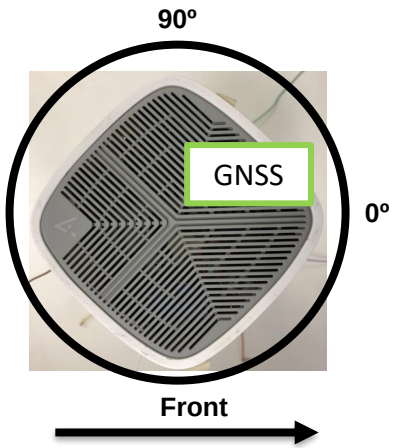
Elevation
(Front to Back) Cut

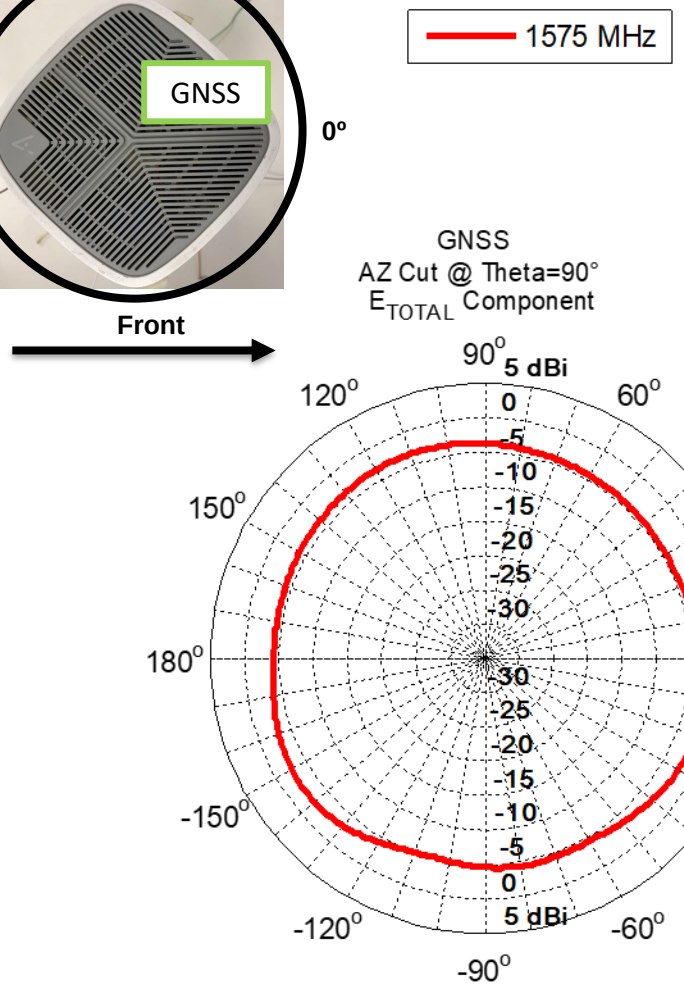




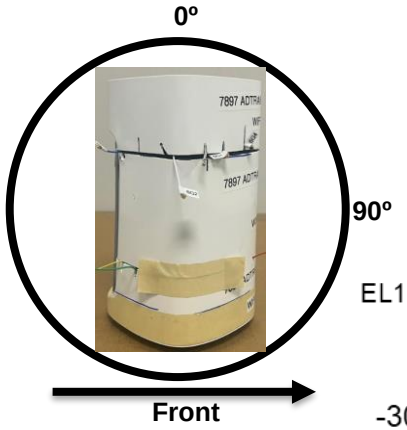
Elevation
(Side to Side) Cut

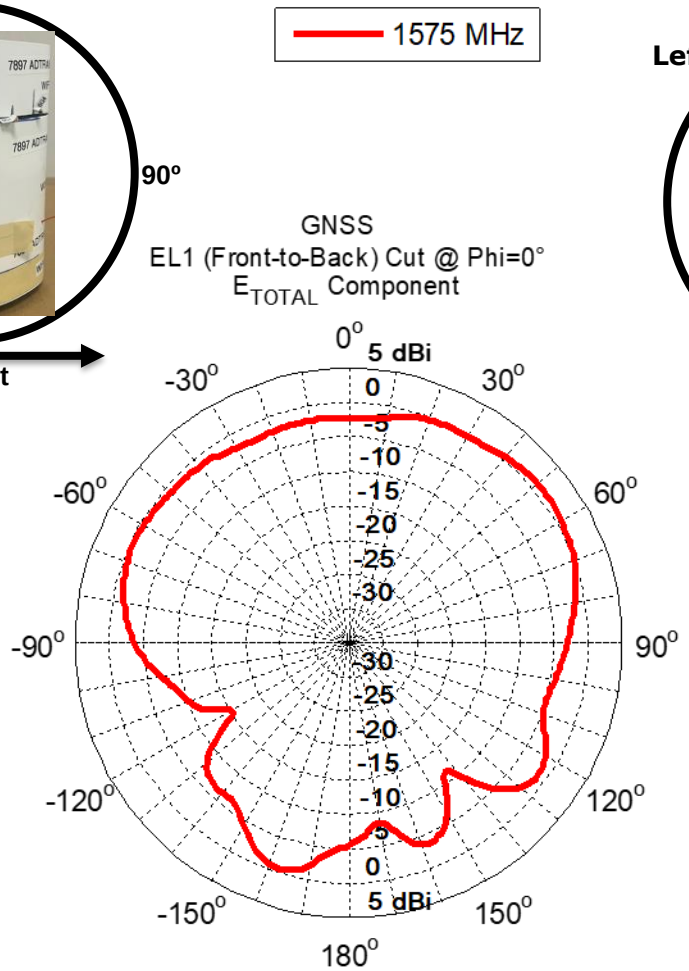
GNSS Antenna Power Sum Gain Patterns



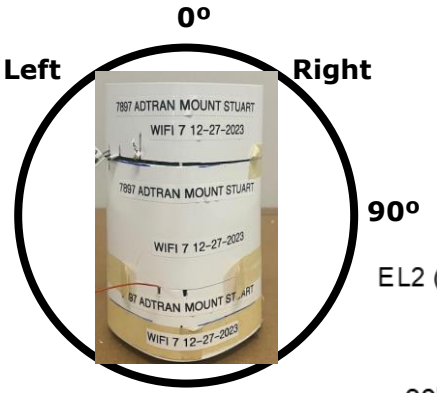


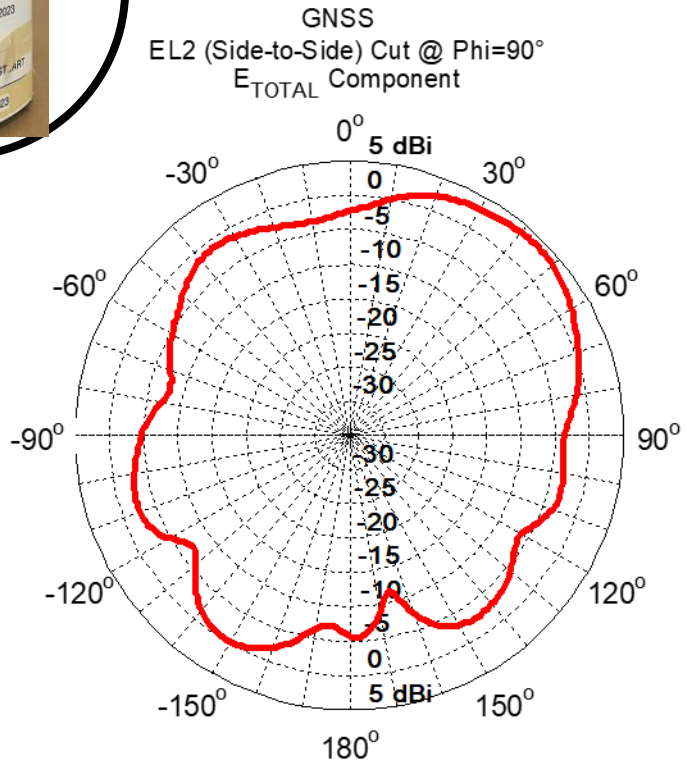
Azimuth Cut ($\theta = 90°$)





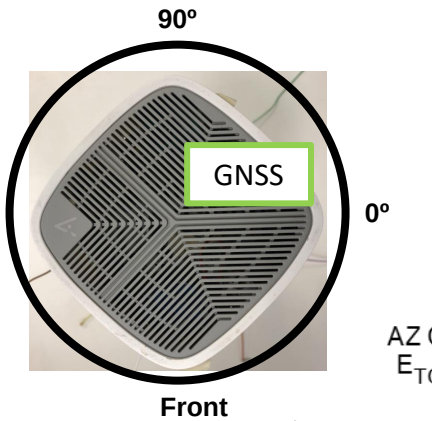
Elevation
(Front to Back) Cut

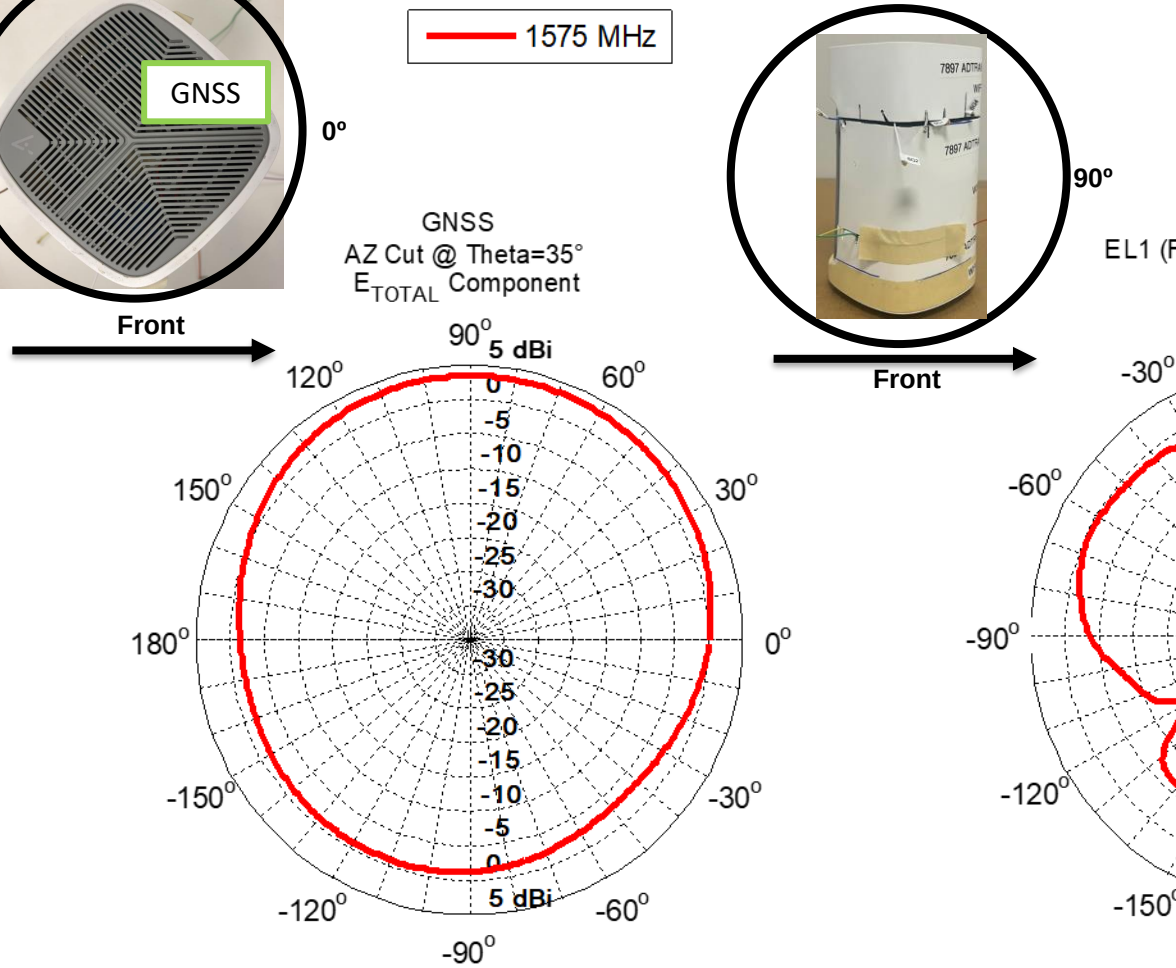


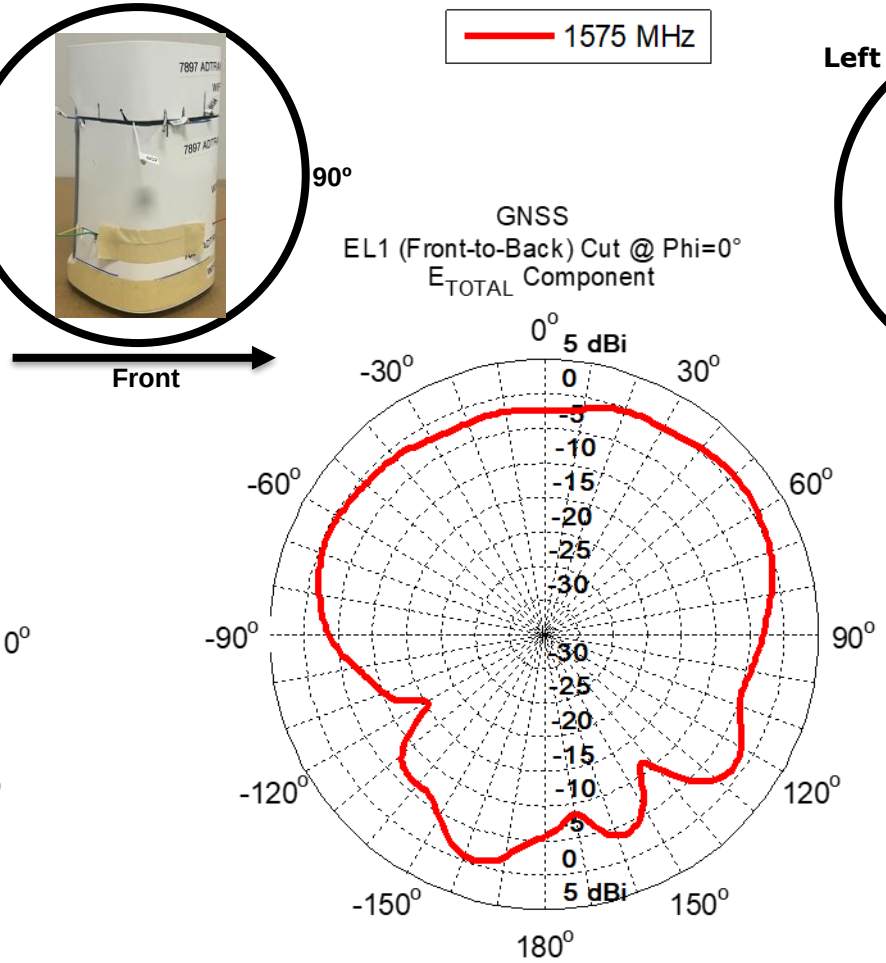


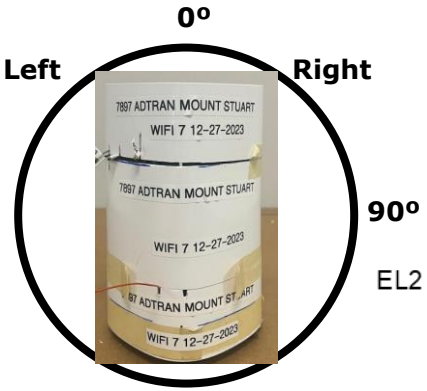
Elevation
(Side to Side) Cut

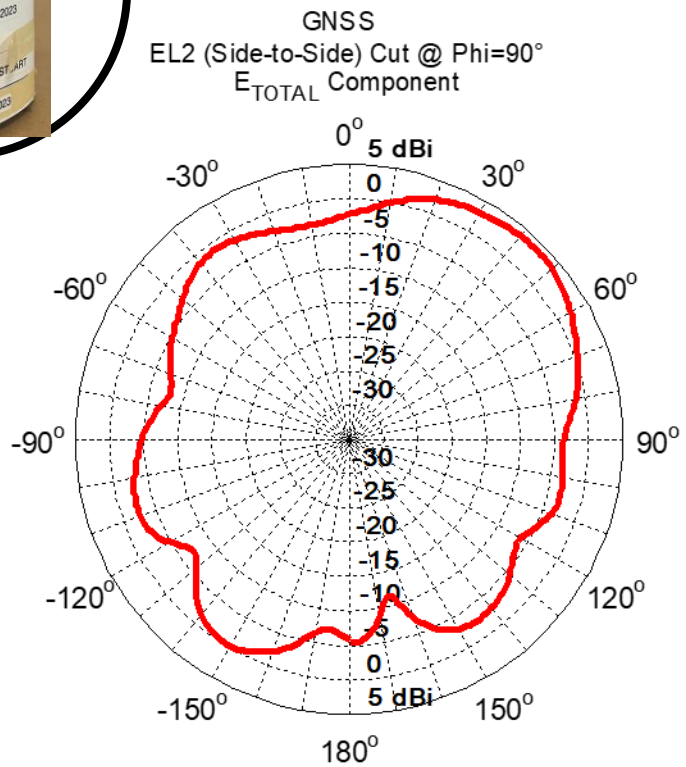
GNSS Antenna Power Sum Gain Patterns









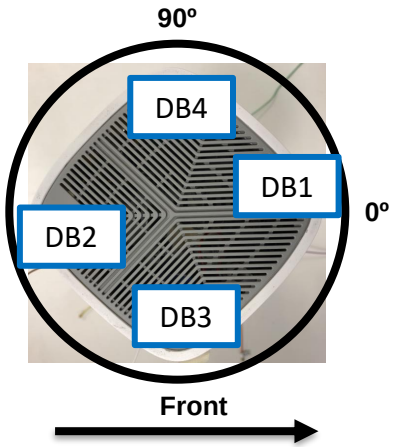


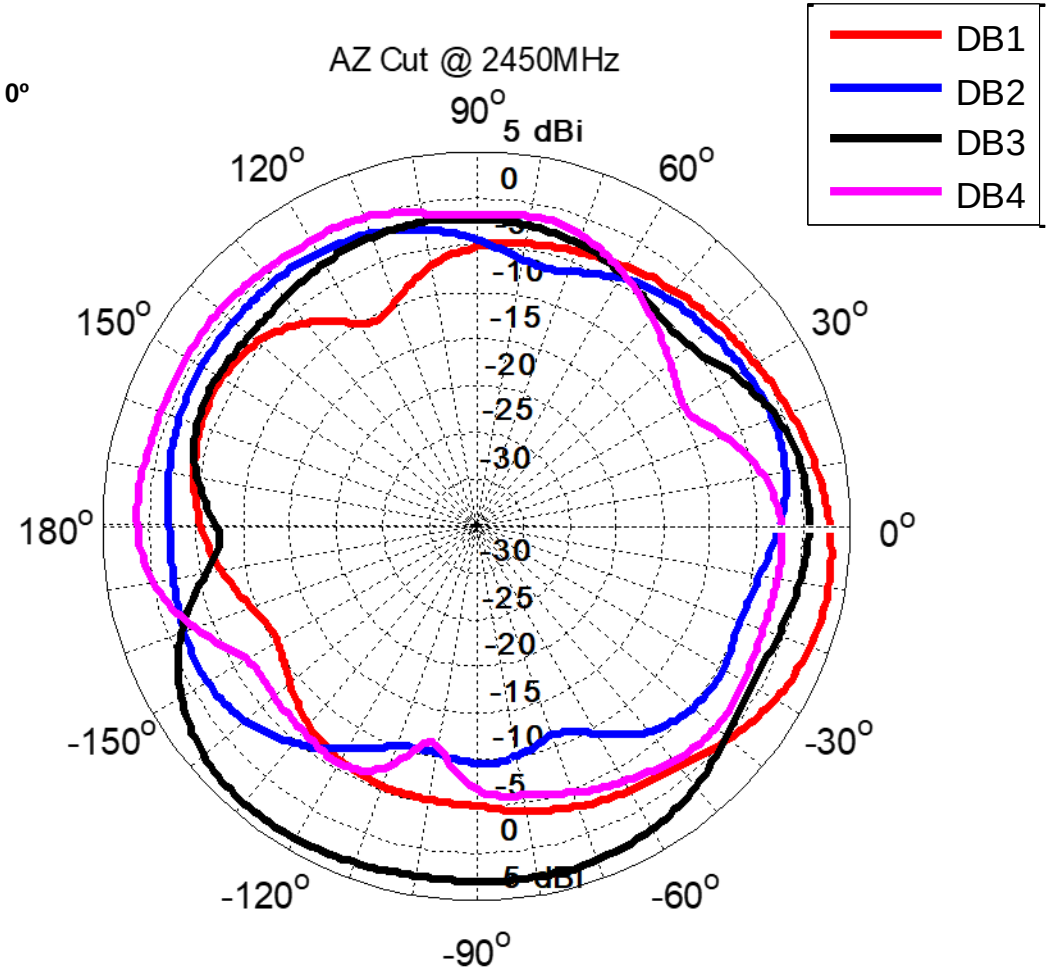
Azimuth Cut ($\theta = 35°$)
GPS inclination angle is 55°

Elevation
(Front to Back) Cut

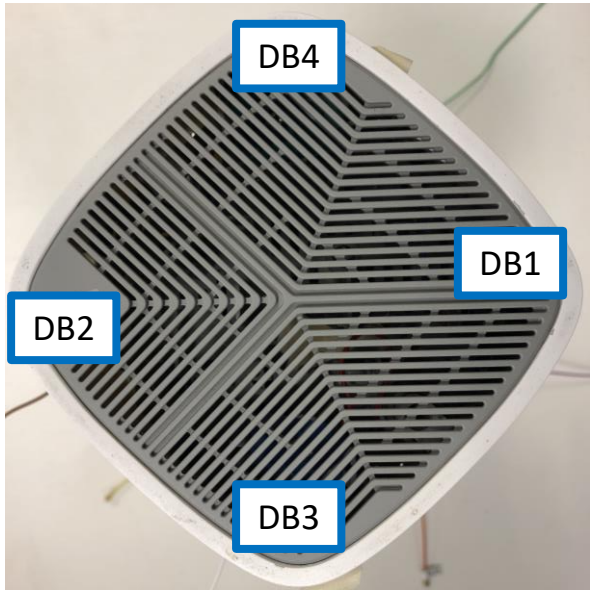
Elevation
(Side to Side) Cut

Azimuth Cut - Power Sum
System Coverage – DB Antennas

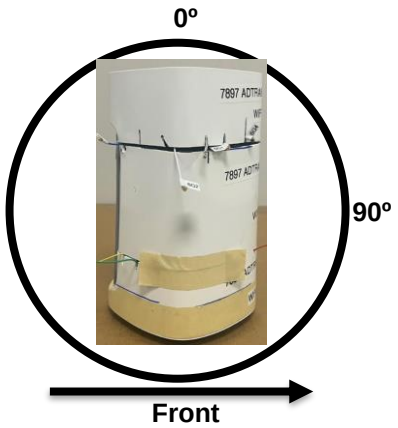


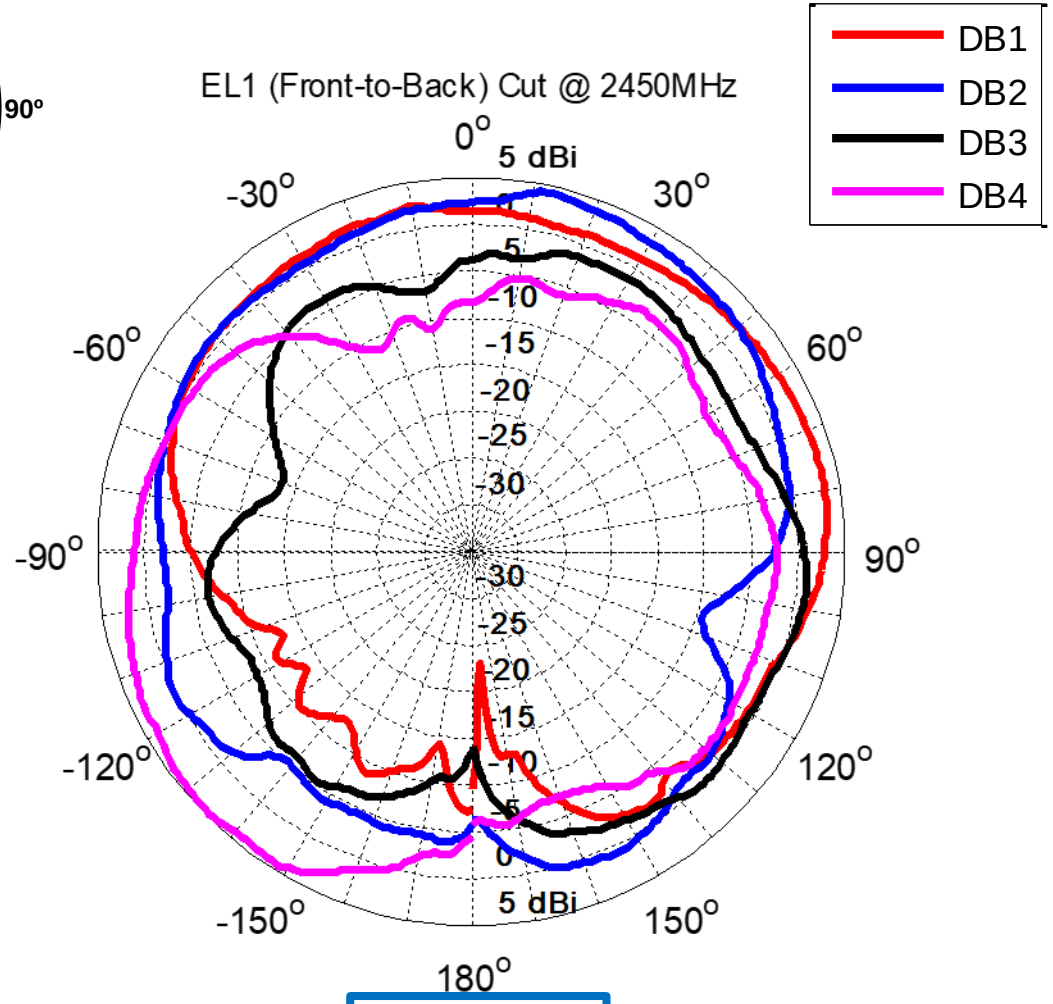


2.45 GHz

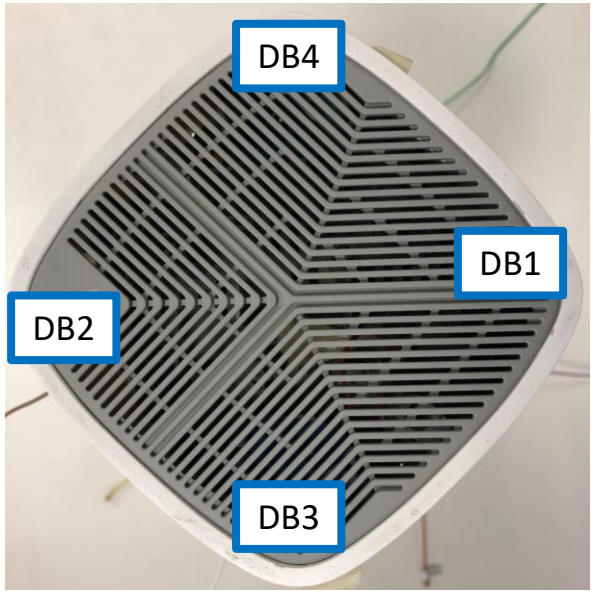


Elevation (Front to Back) Cut - Power Sum System Coverage – DB Antennas

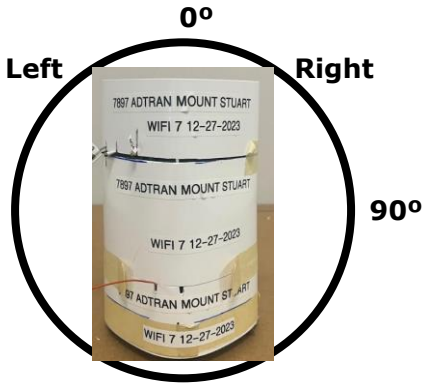


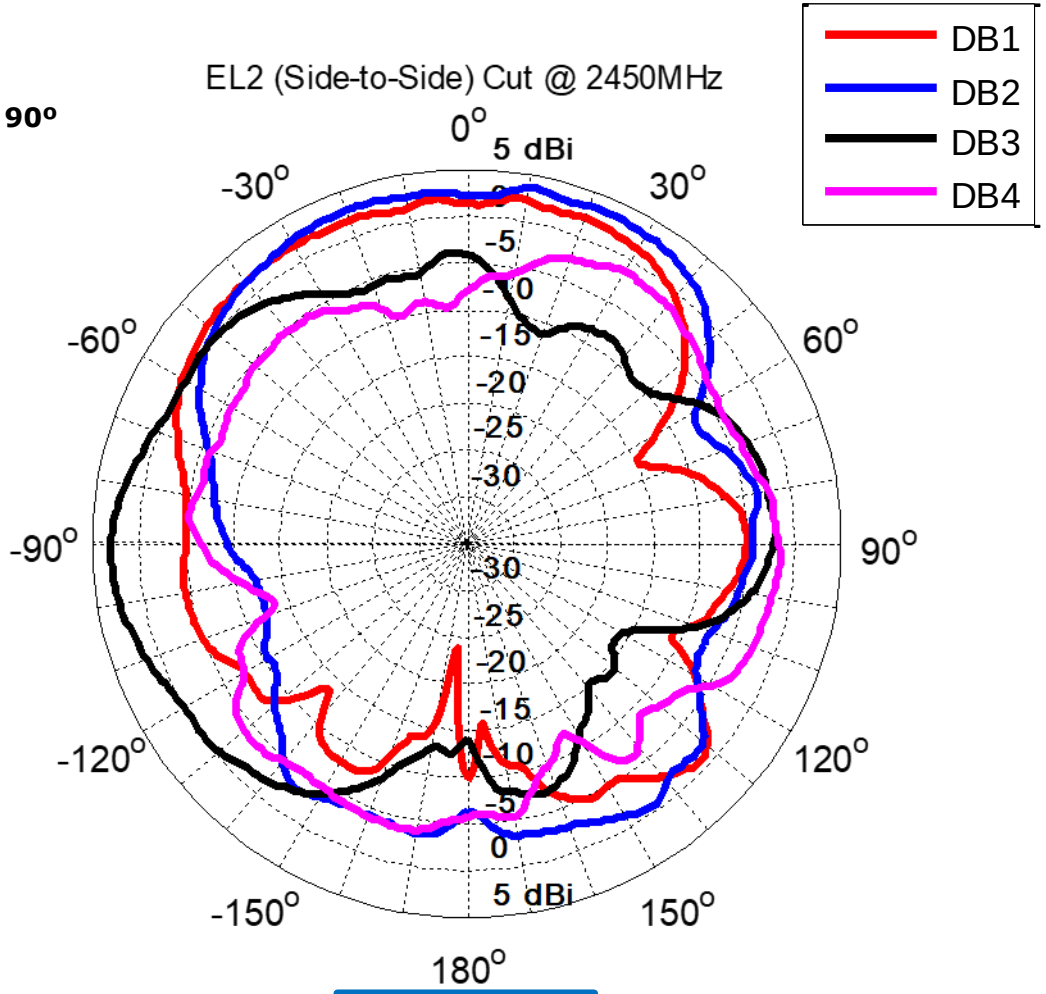


2.45 GHz

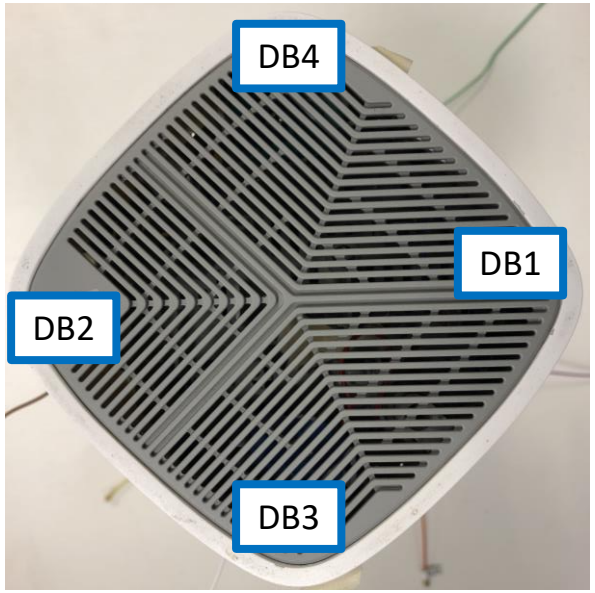


Elevation (Side to Side) Cut - Power Sum System Coverage – DB Antennas

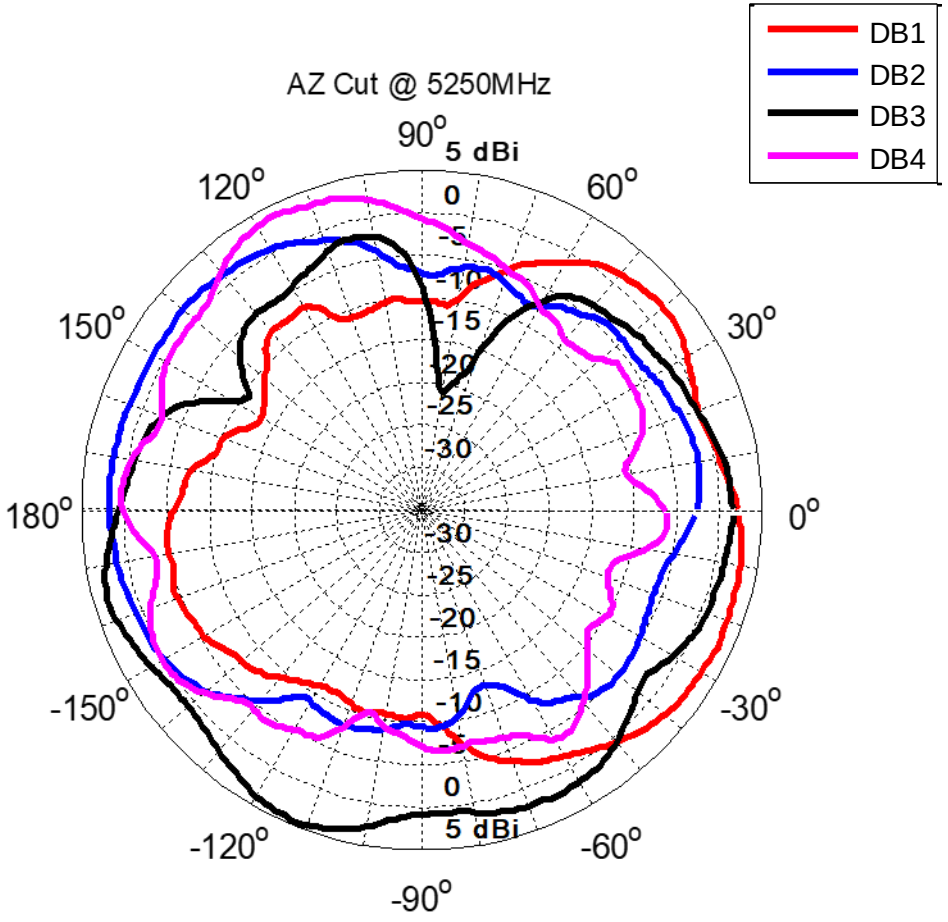




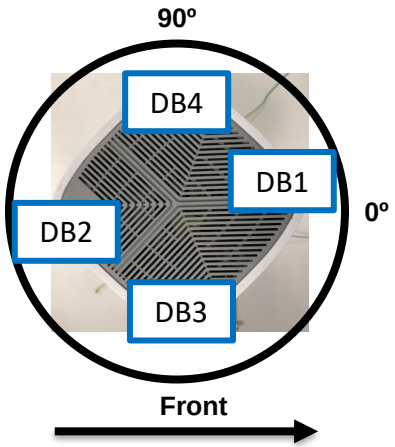
2.45 GHz

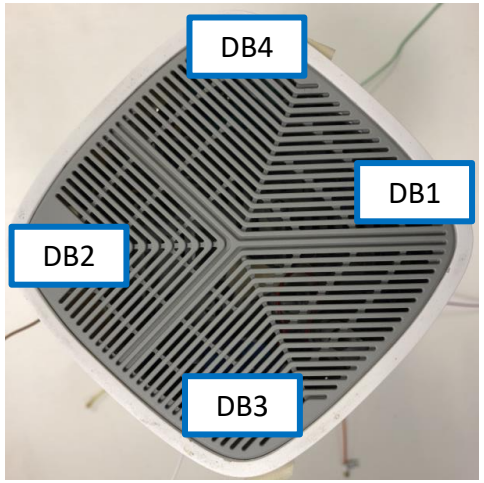


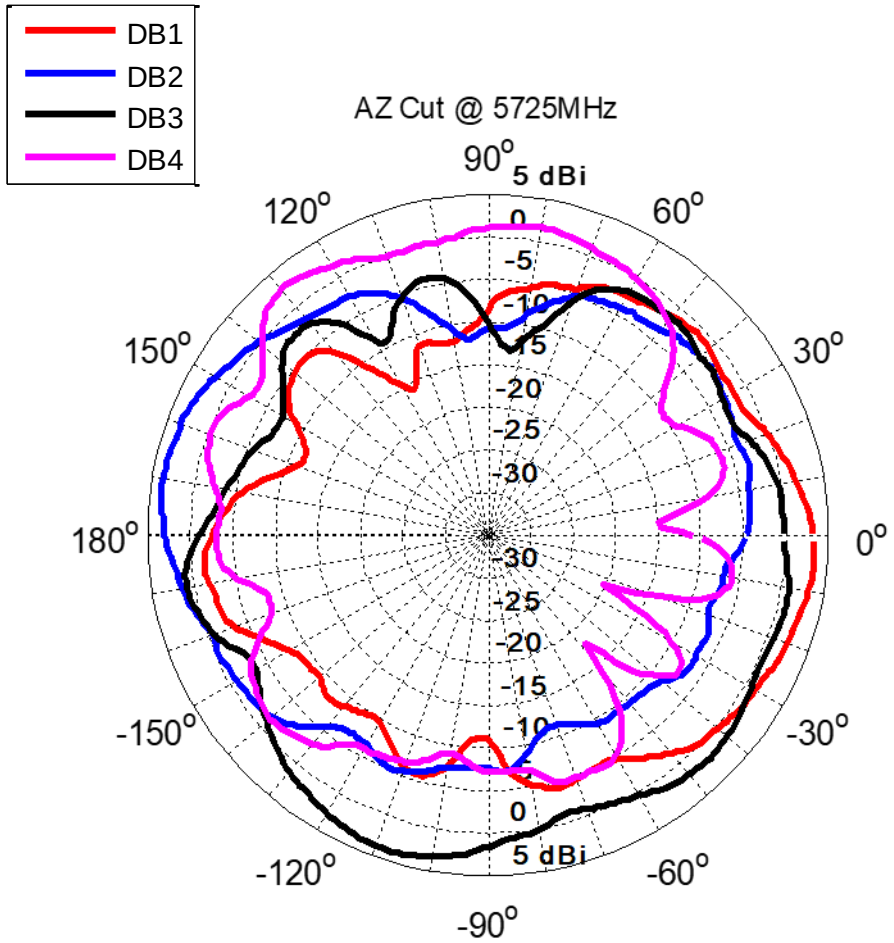
Azimuth Cut - Power Sum
System Coverage – DB Antennas



Dual Band – 5.25 GHz

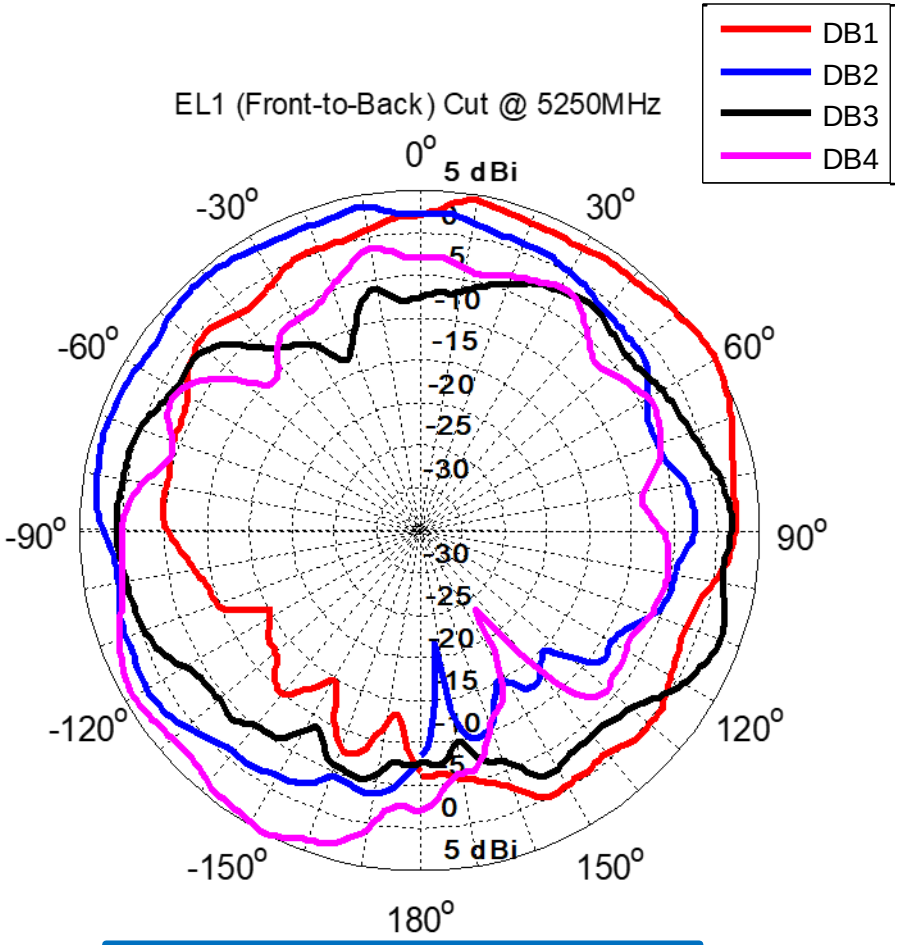




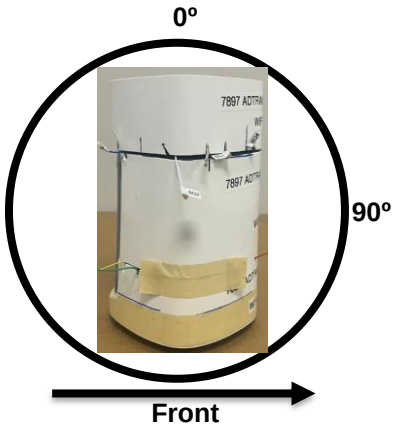


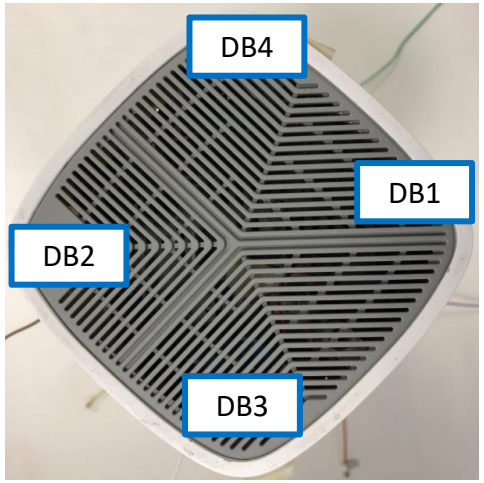
Dual Band – 5.725 GHz

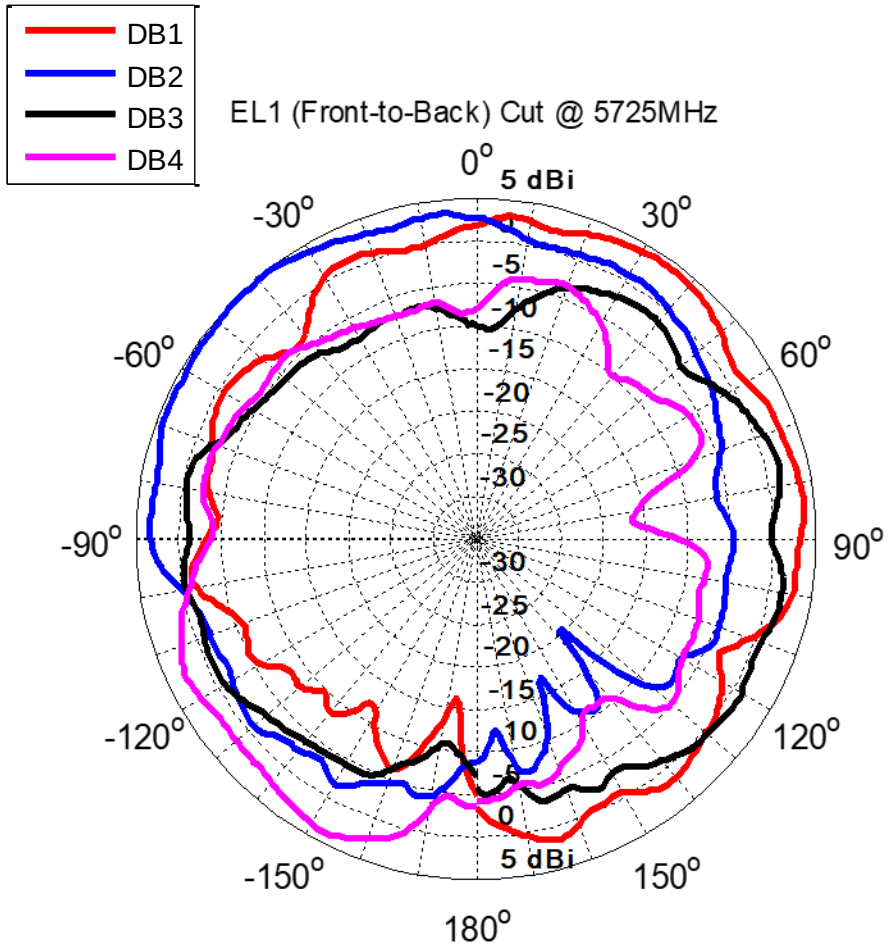
Elevation (Front to Back) Cut - Power Sum System Coverage – DB Antennas



Dual Band – 5.25 GHz

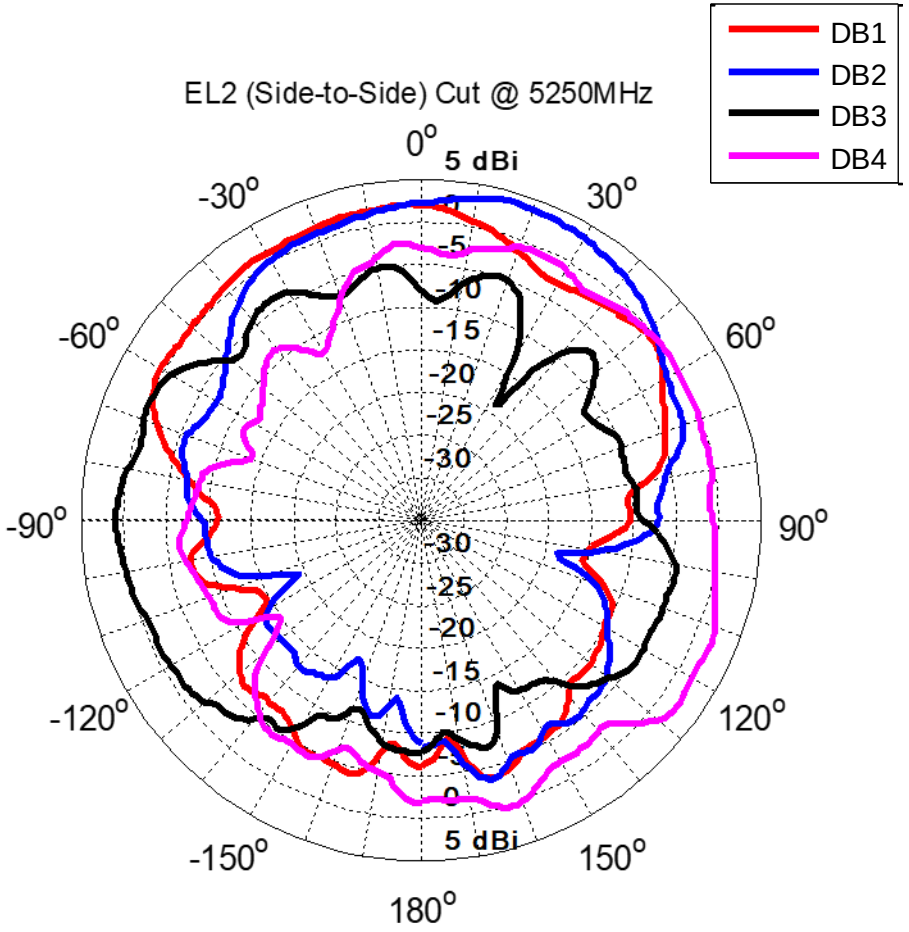




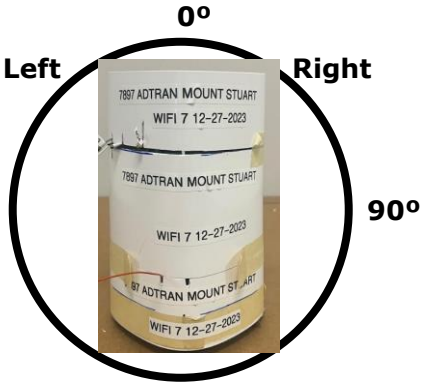


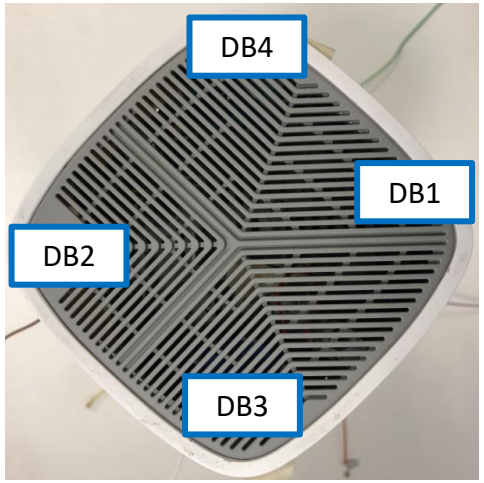
Dual Band – 5.725 GHz

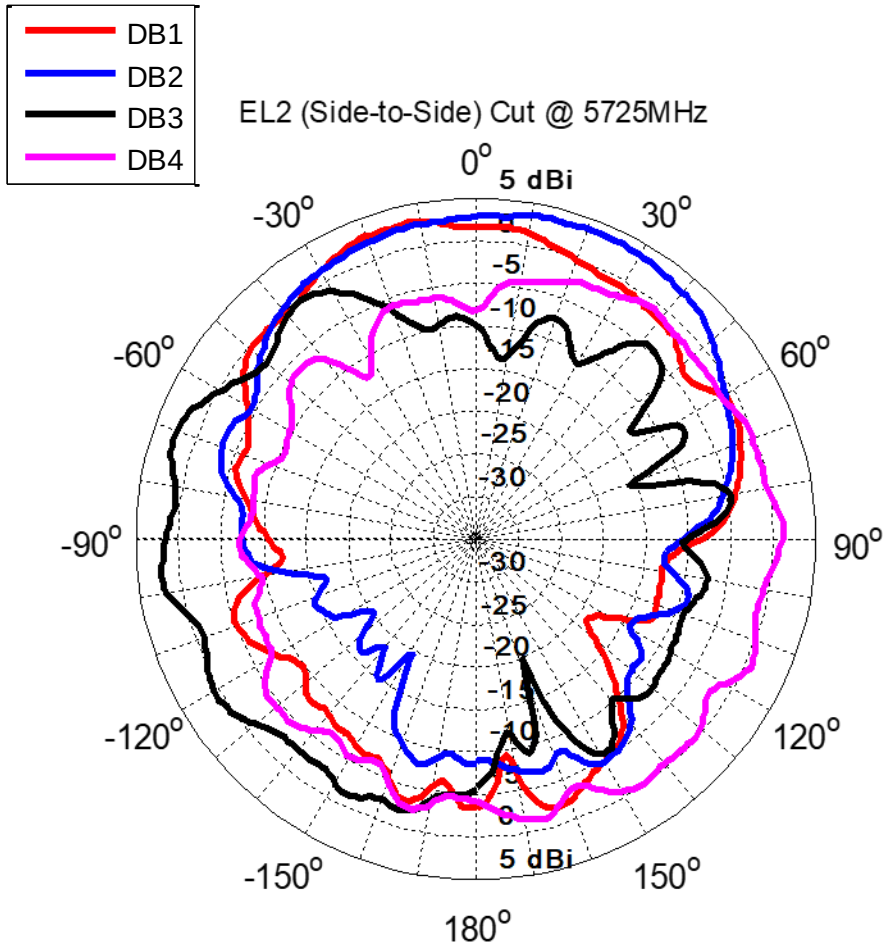
Elevation (Side to Side) Cut - Power Sum System Coverage – DB Antennas



Dual Band – 5.25 GHz

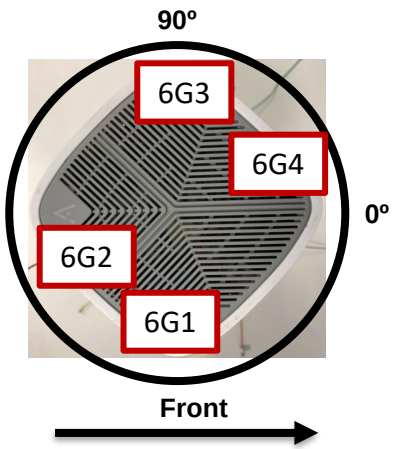


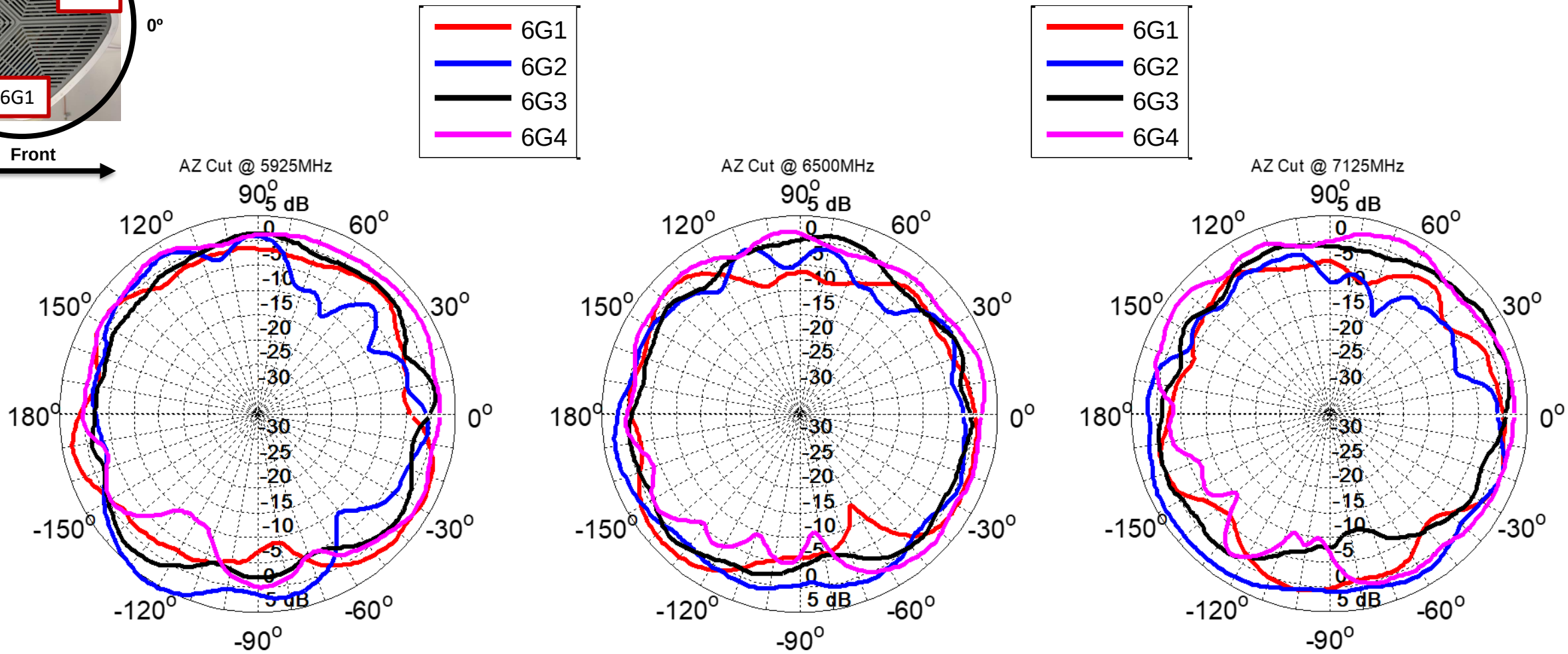




Dual Band – 5.725 GHz

Azimuth Cut - Power Sum
System Coverage – 6 GHz Antennas



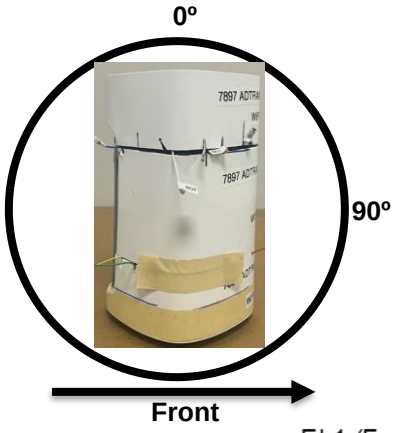


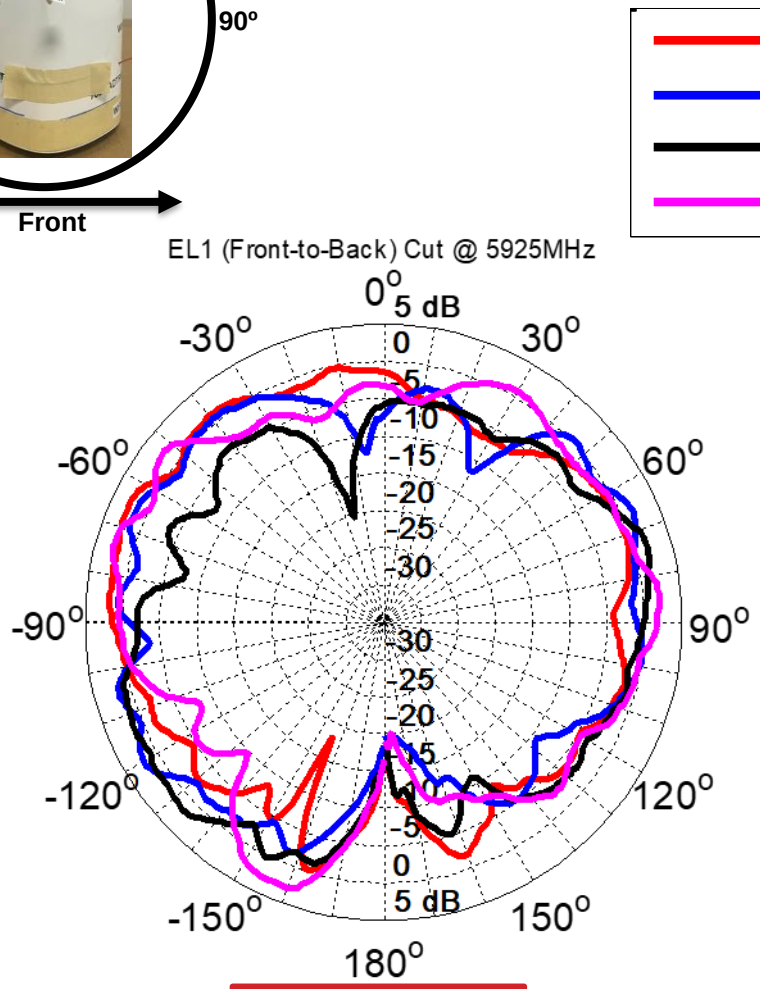
5925 MHz

6500 MHz

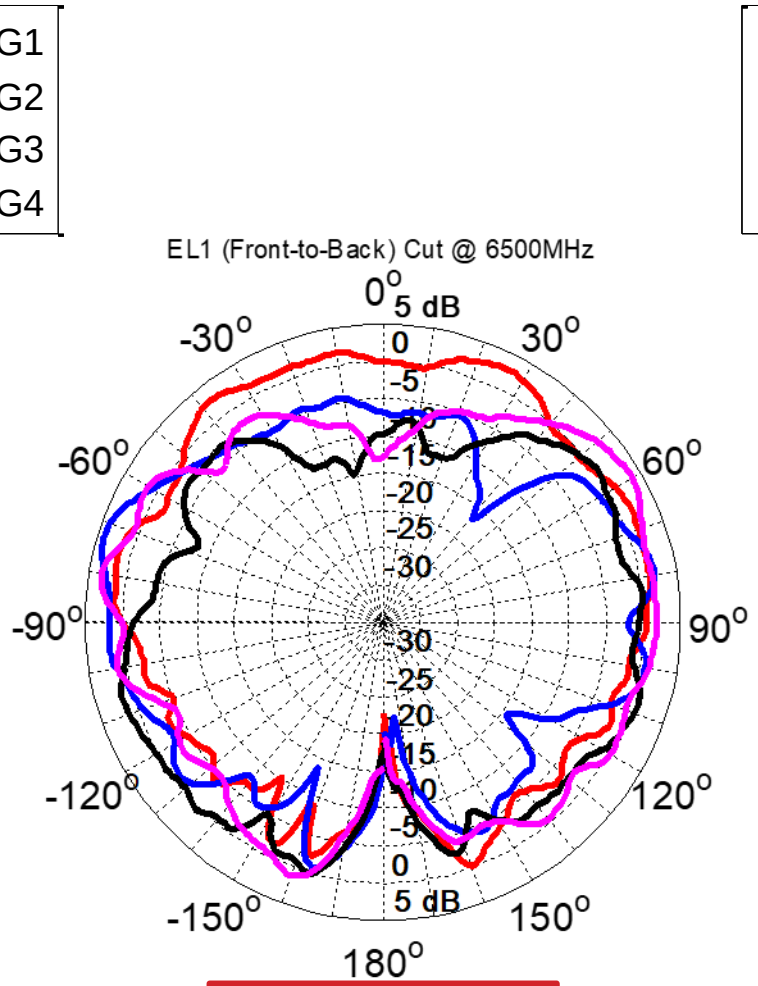
7125 MHz

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

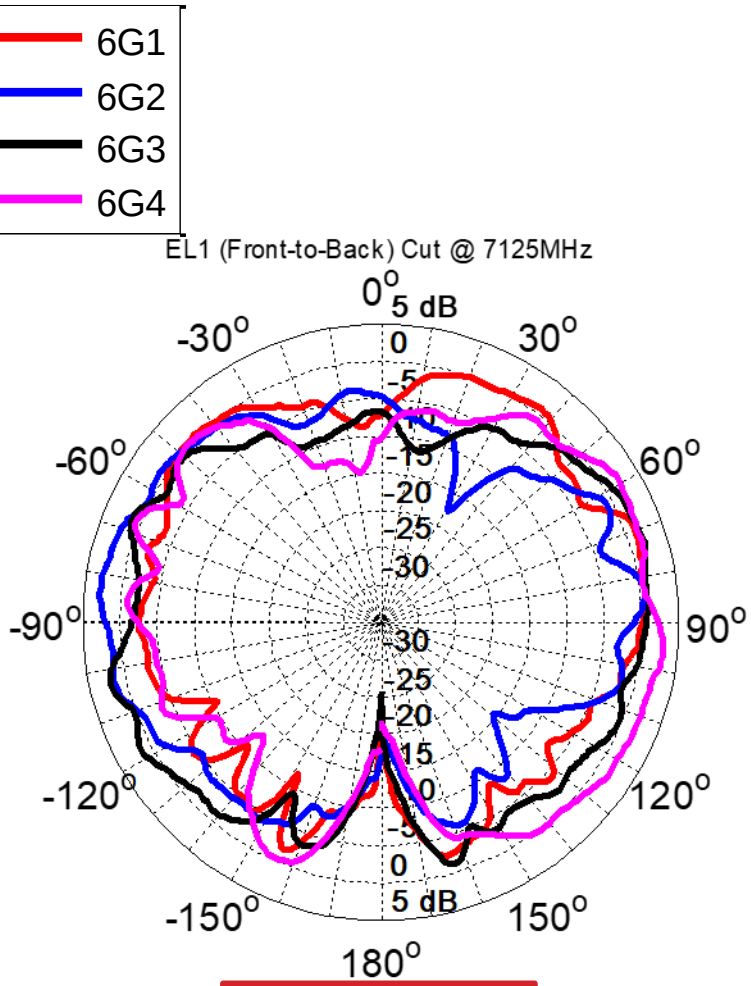




5925 MHz

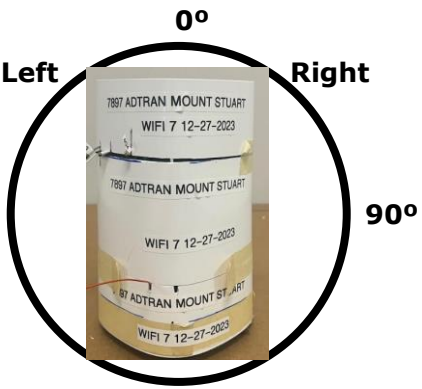


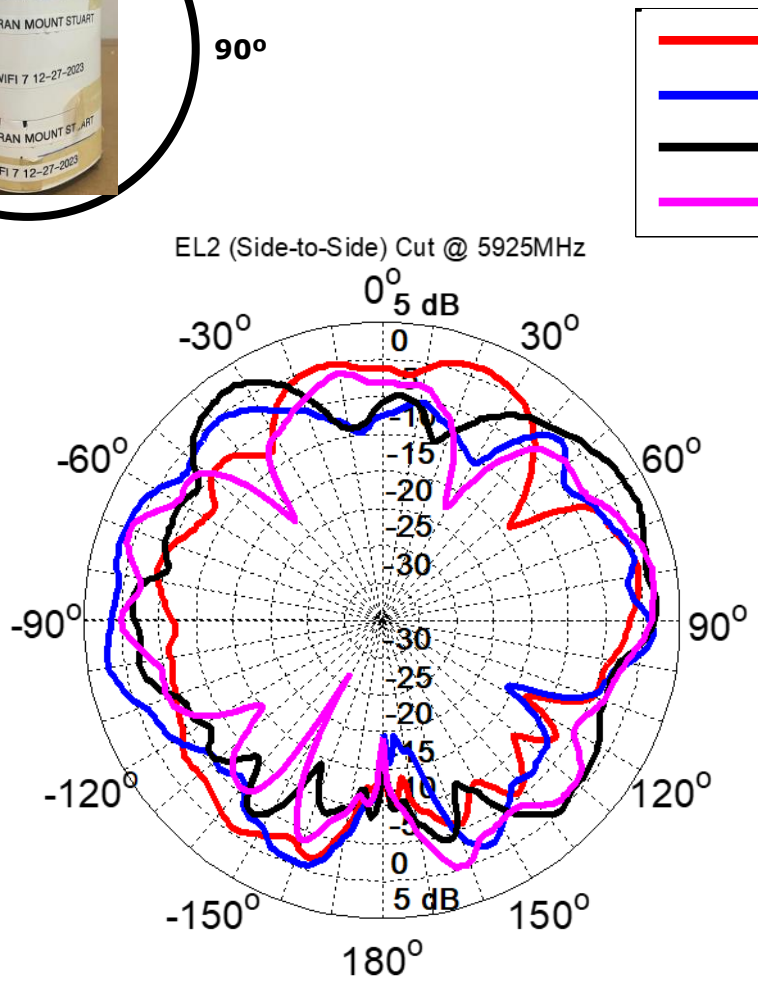
6500 MHz



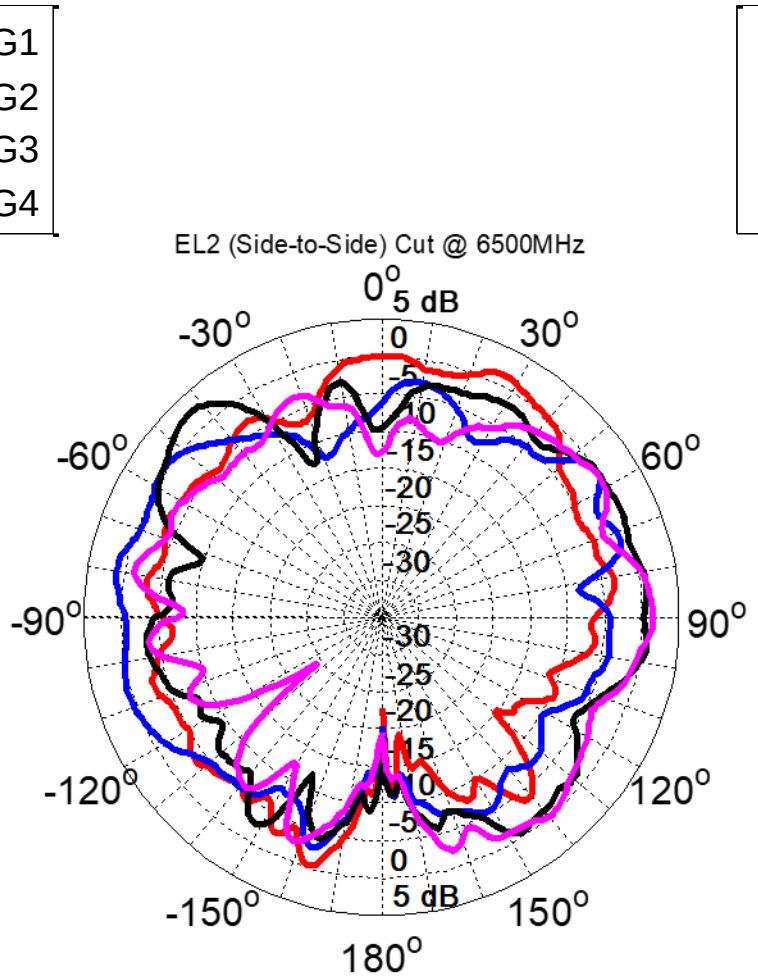
7125 MHz

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

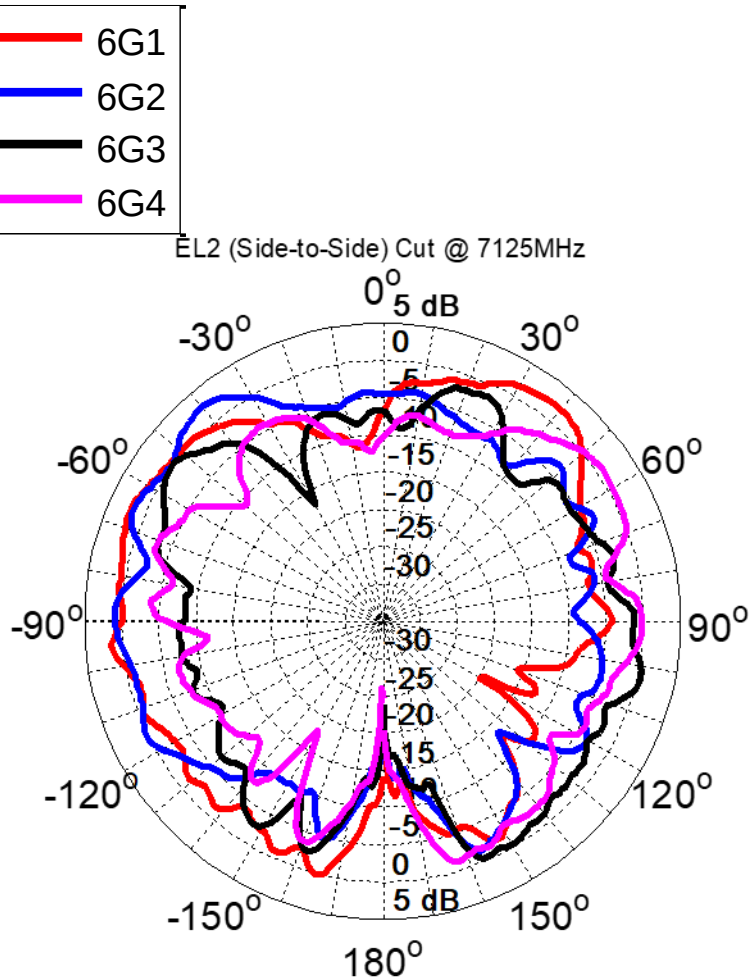




5925 MHz

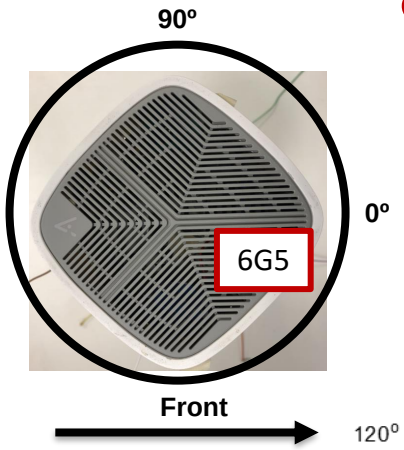


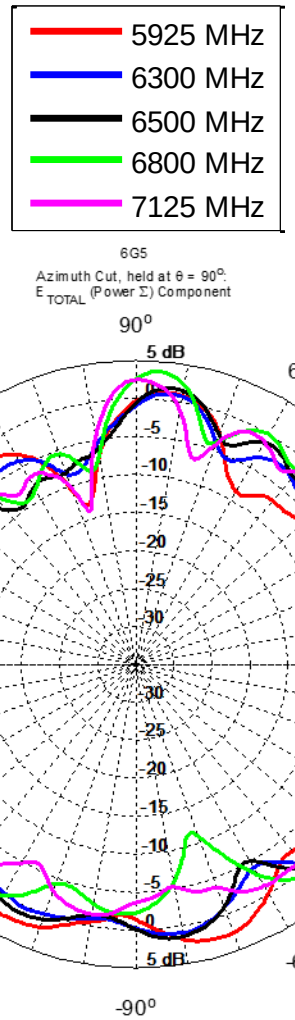
6500 MHz



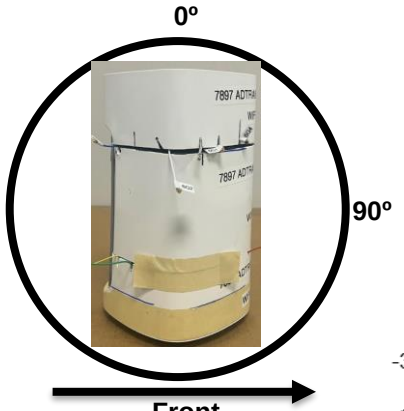
7125 MHz

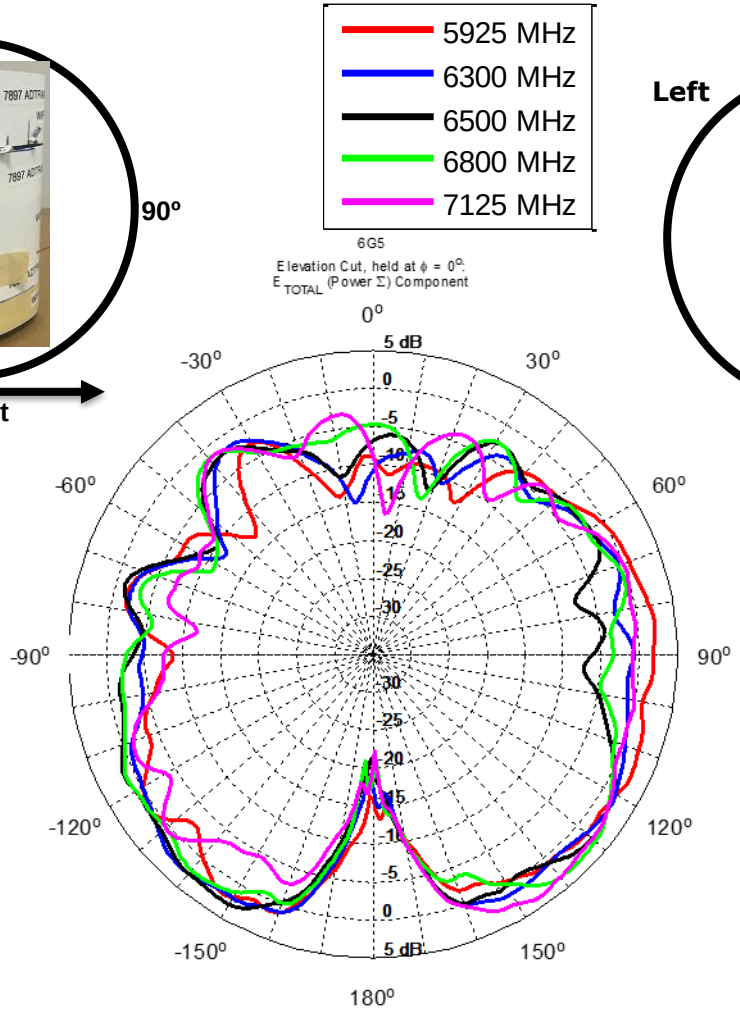
6 GHz (RX-Only) Antenna Power Sum Gain Patterns



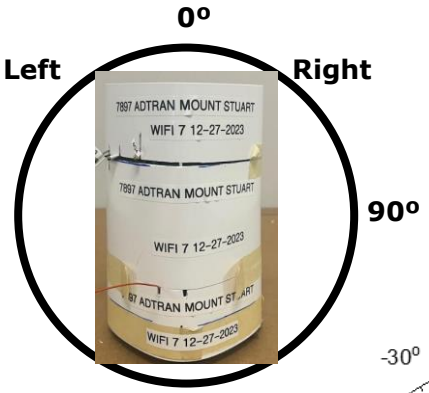


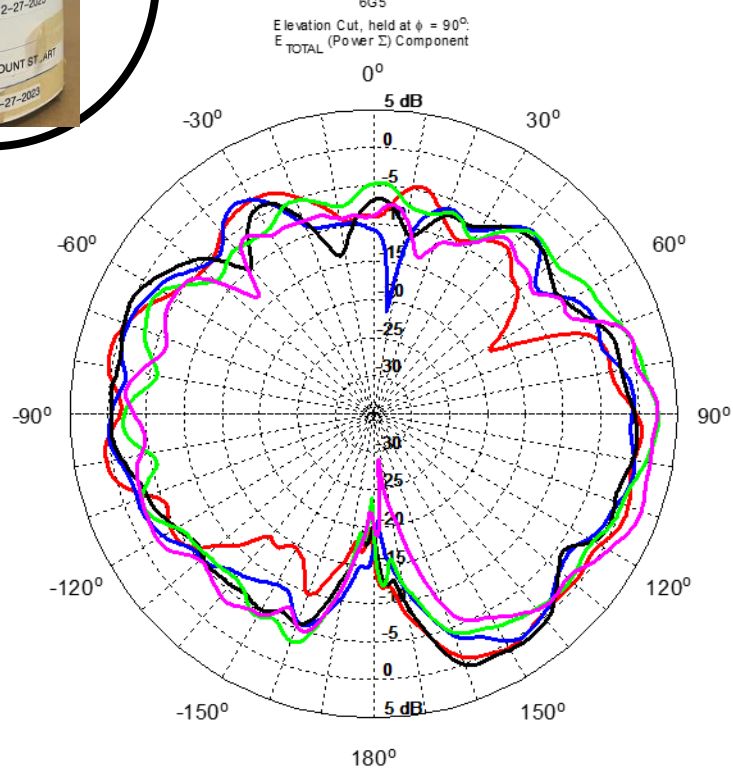
Azimuth Cut





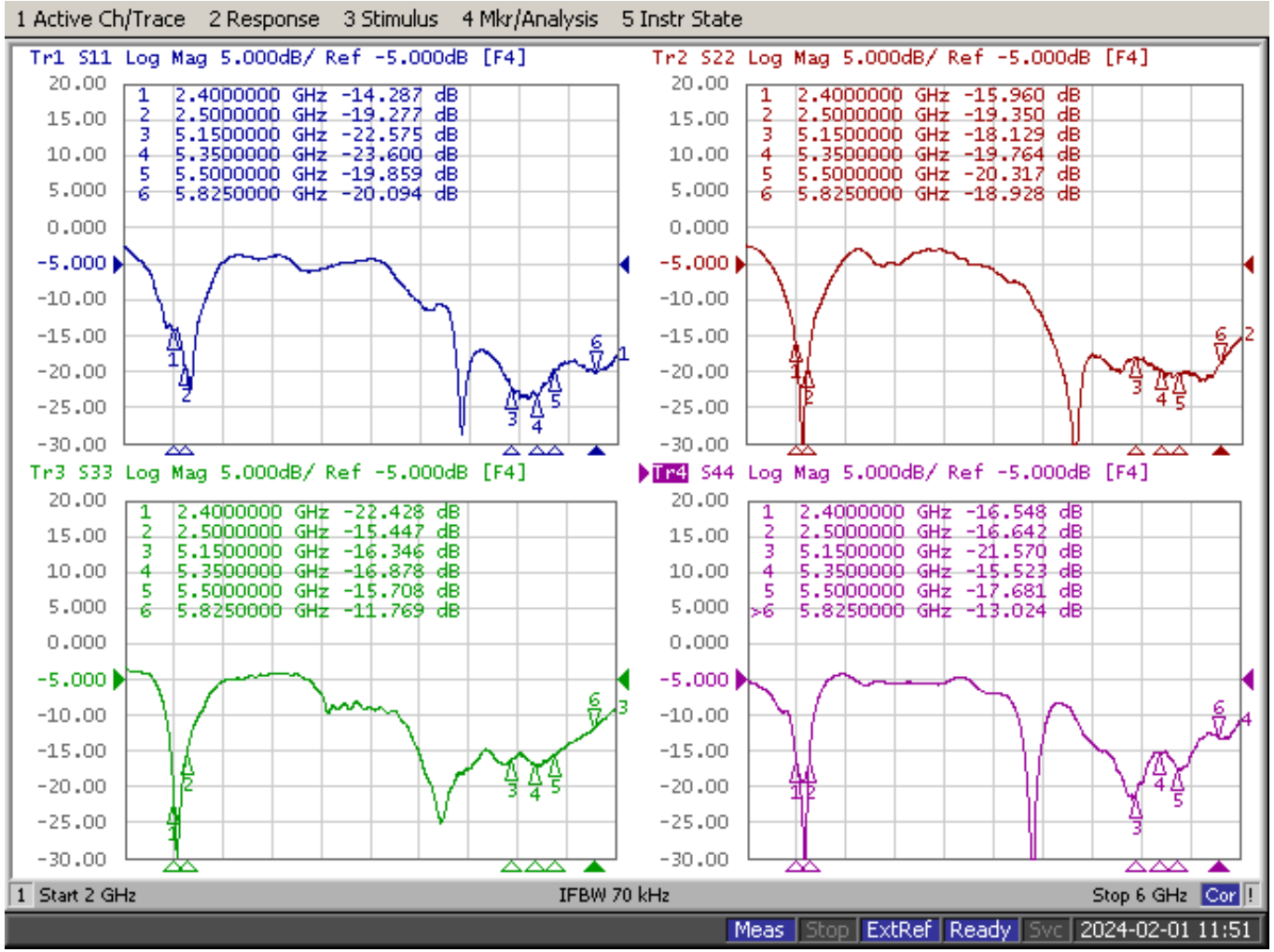
Elevation
(Front to Back) Cut



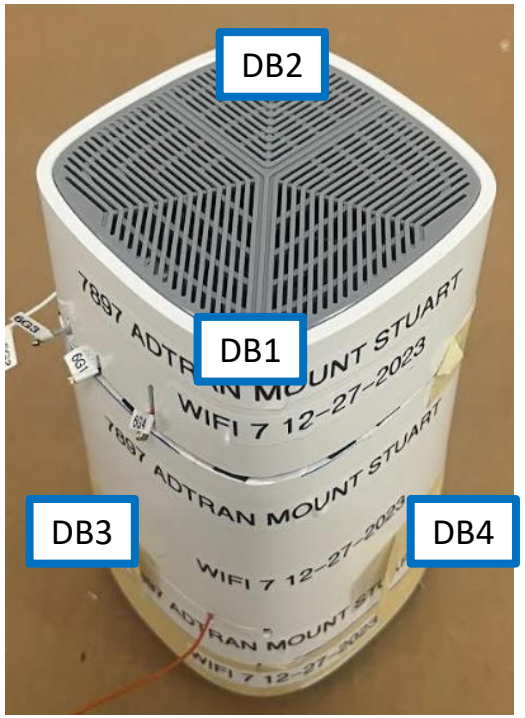


Elevation
(Side to Side) Cut

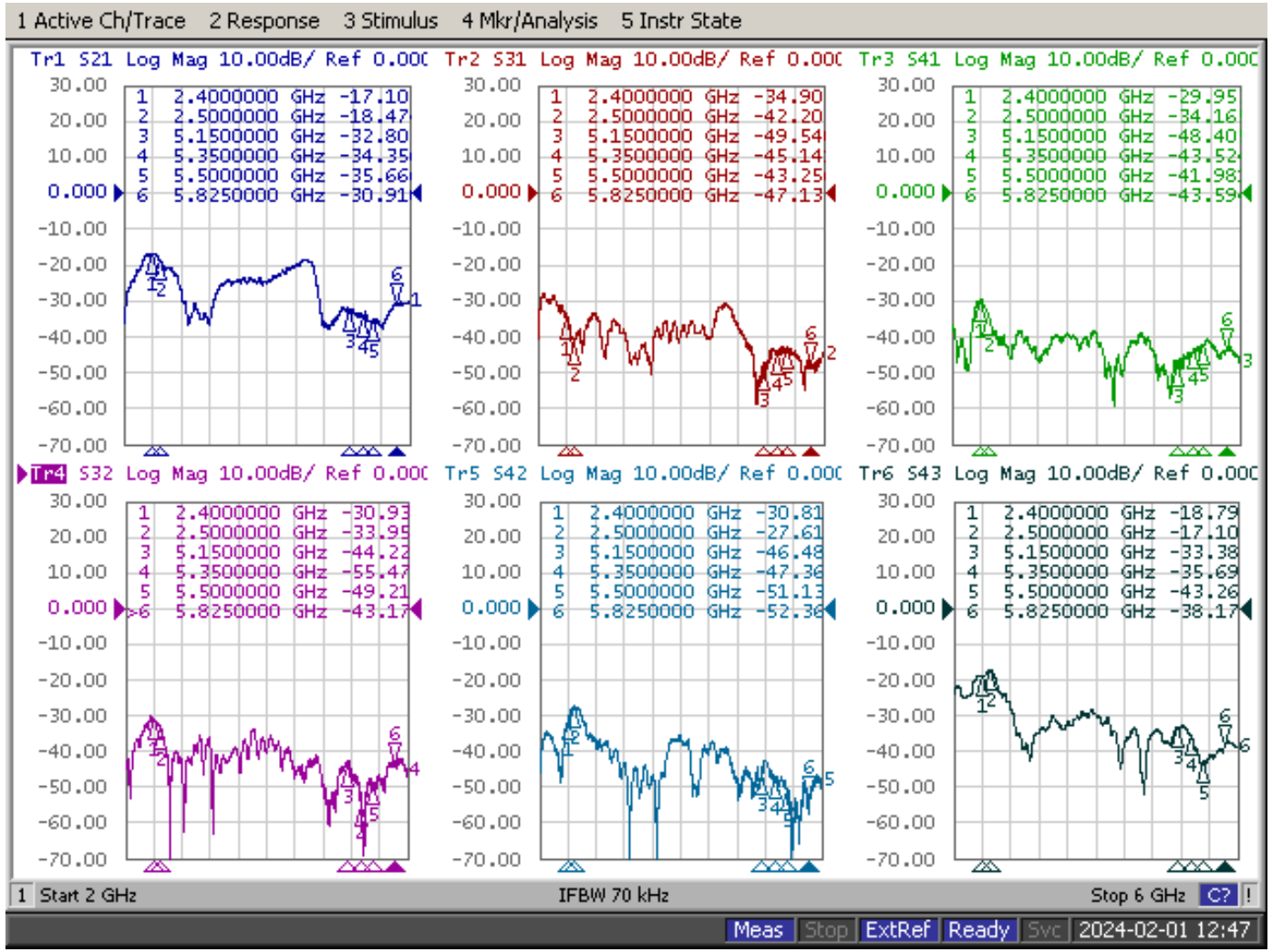
Return Loss of the Dual Band Antennas



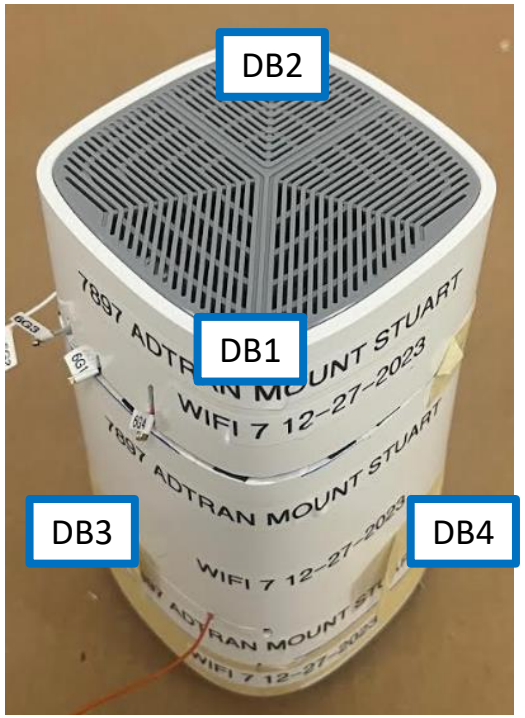
Port 1= DB1	Port 2= DB2
Port 3= DB3	Port 4= DB4



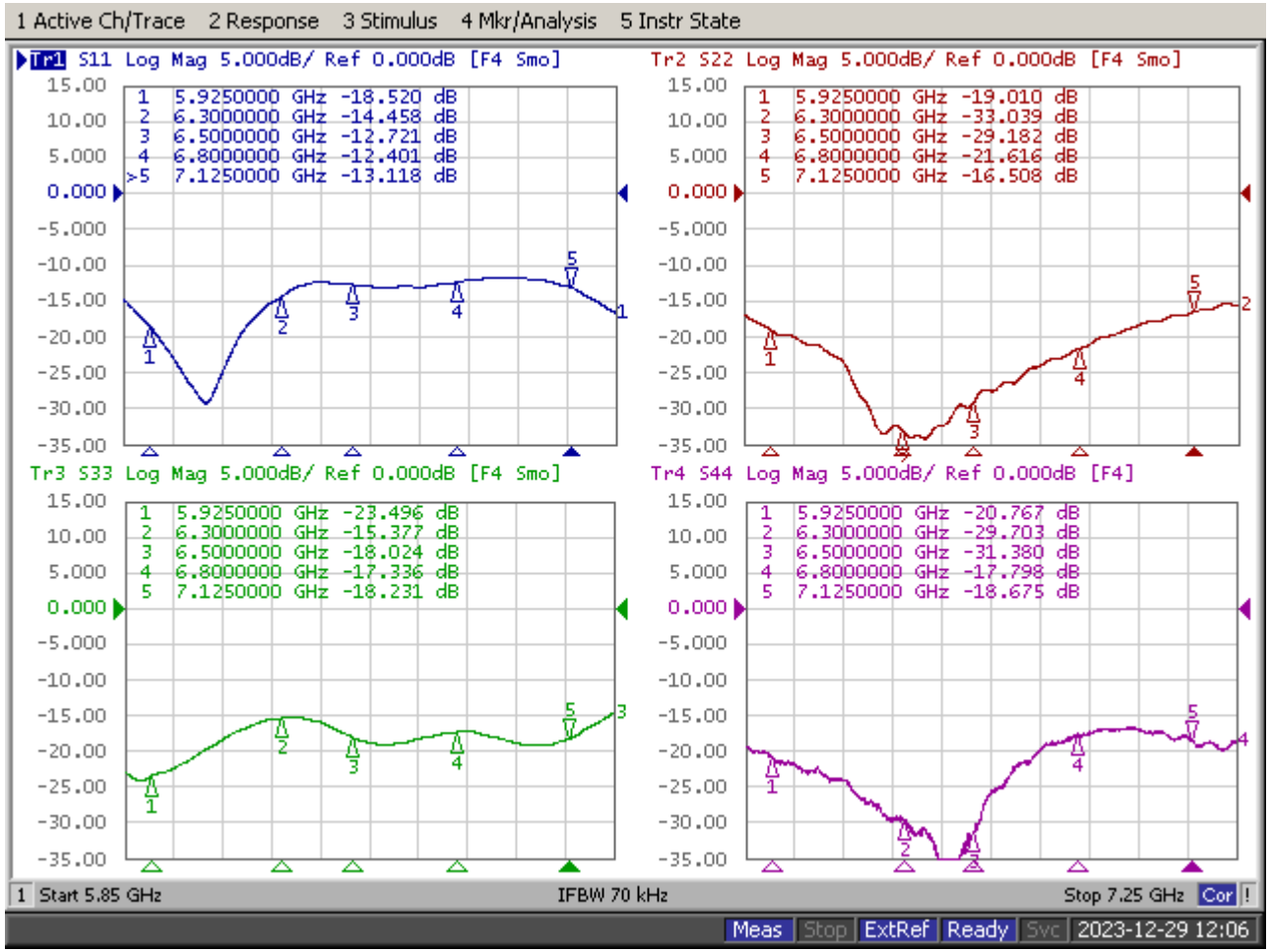
Isolation of the Dual Band Antennas



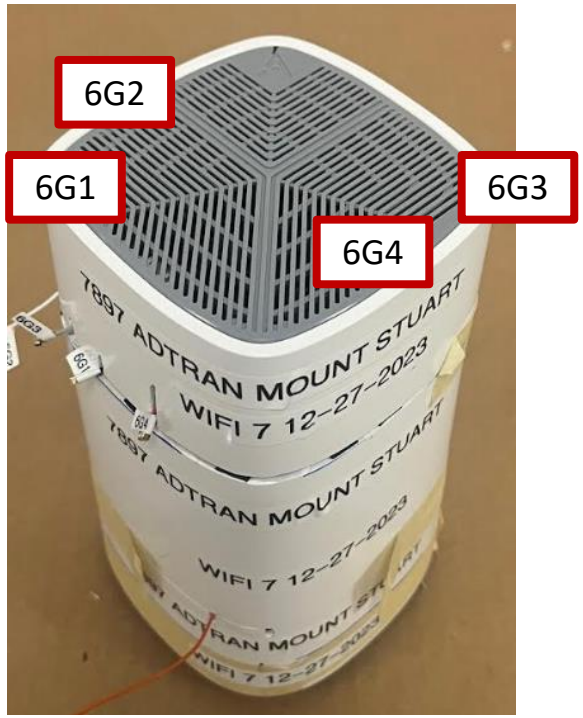
Port 1= DB1	Port 2= DB2
Port 3= DB3	Port 4= DB4



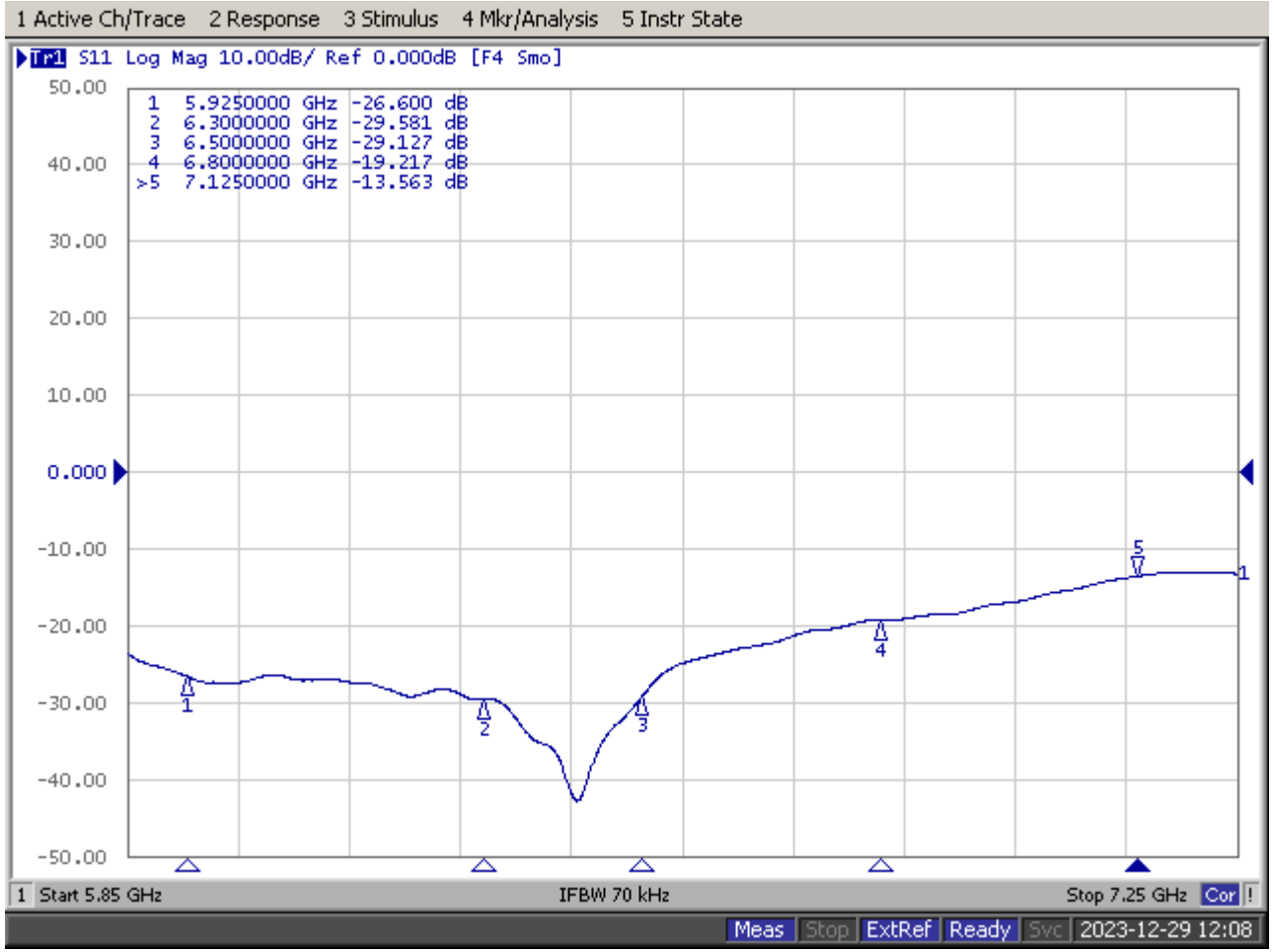
Return Loss of 6 GHz Antennas



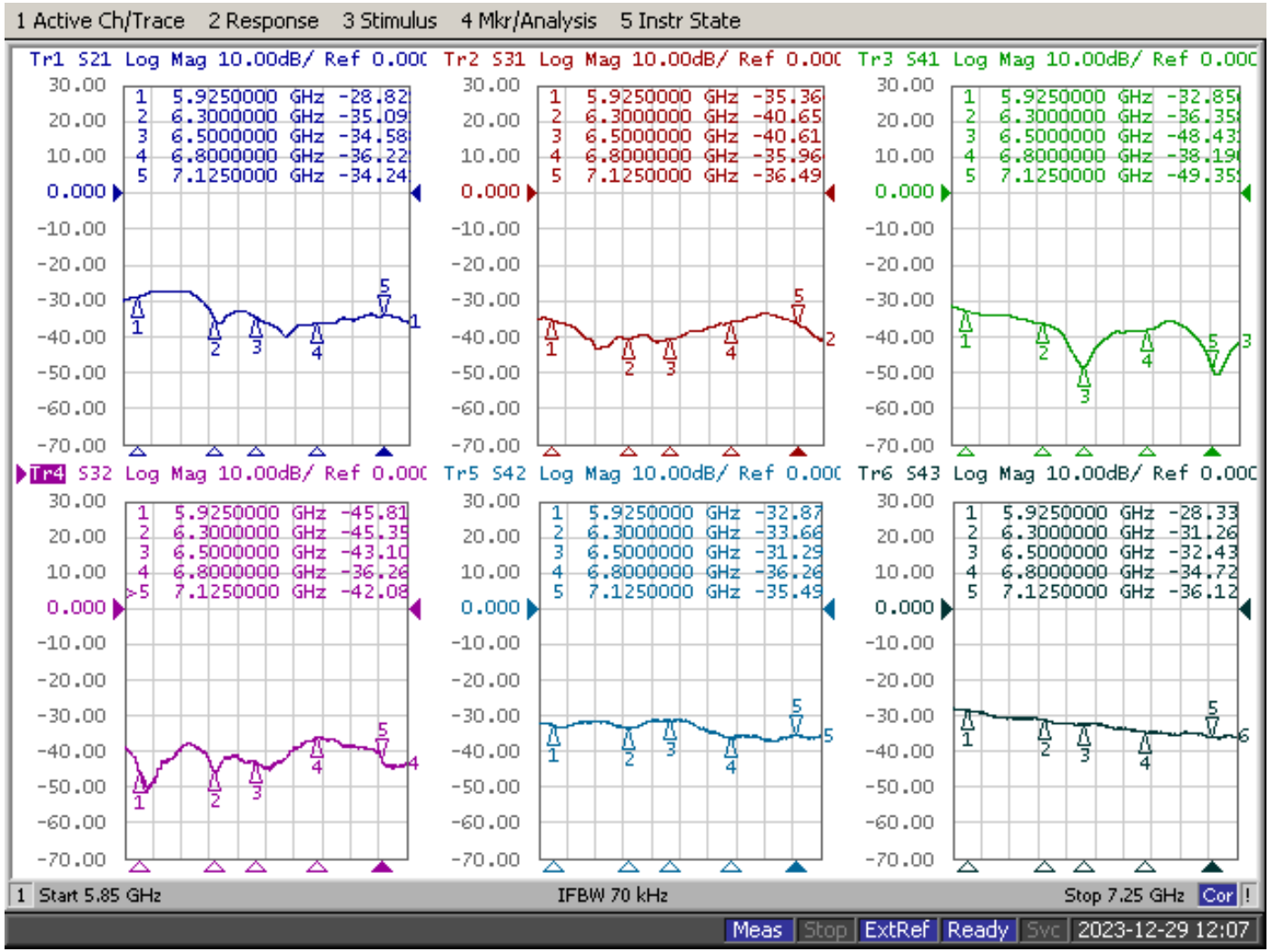
Port 1= 6G1	Port 2=6G2
Port 3= 6G3	Port 4= 6G4



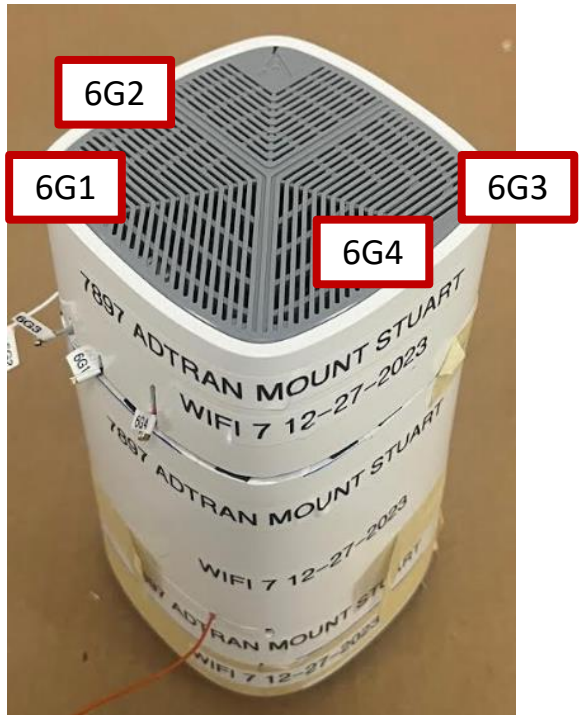
Return Loss of 6 GHz (RX-only) Antenna



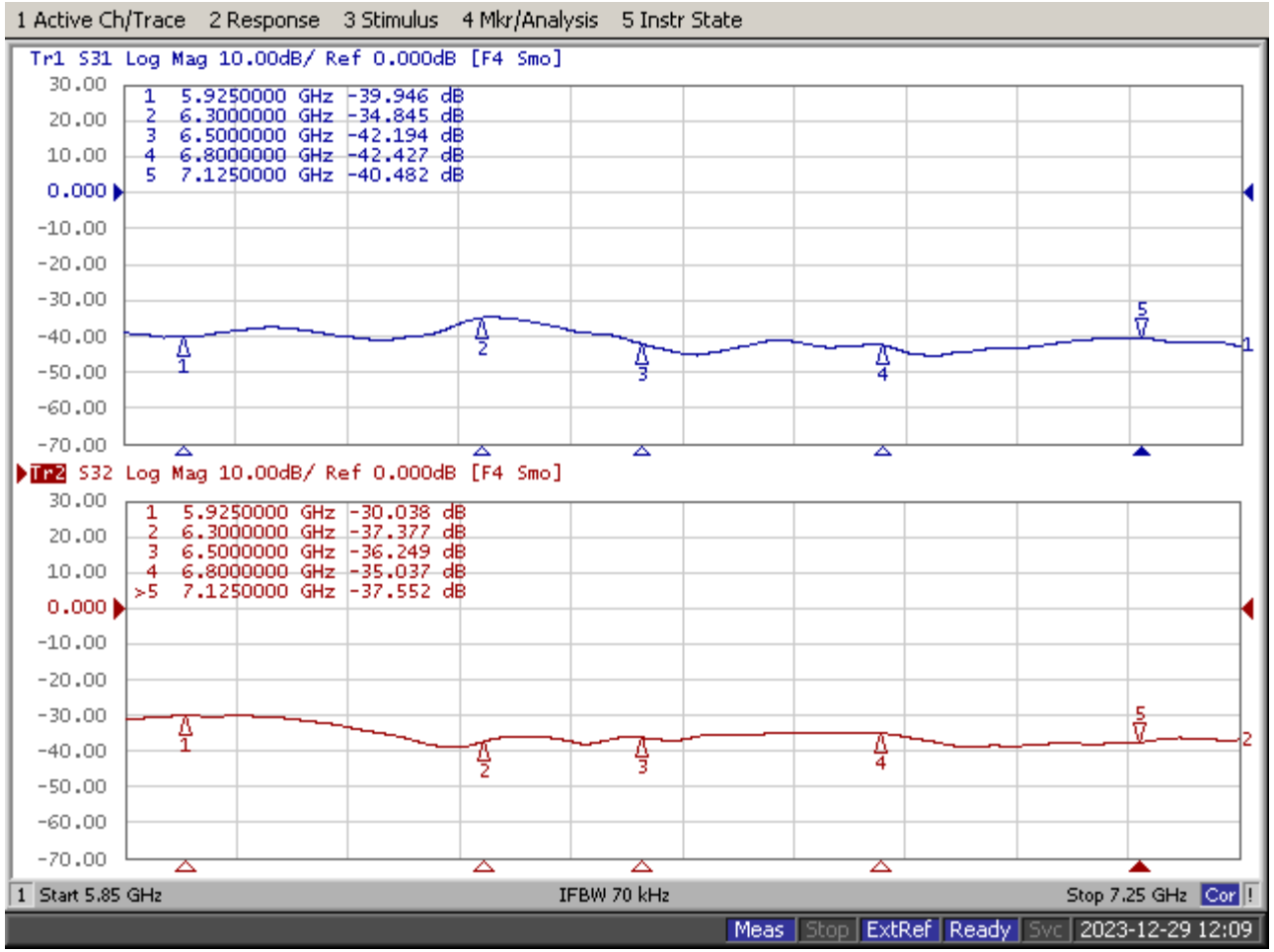
Isolation between 6 GHz Antennas



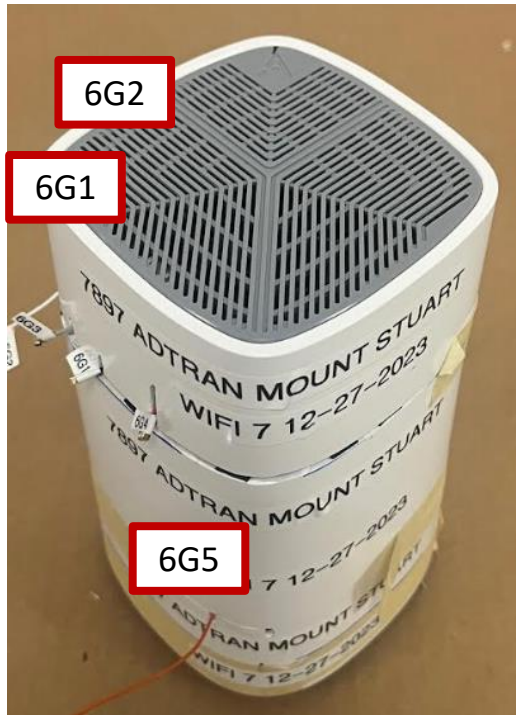
Port 1= 6G1	Port 2=6G2
Port 3= 6G3	Port 4= 6G4



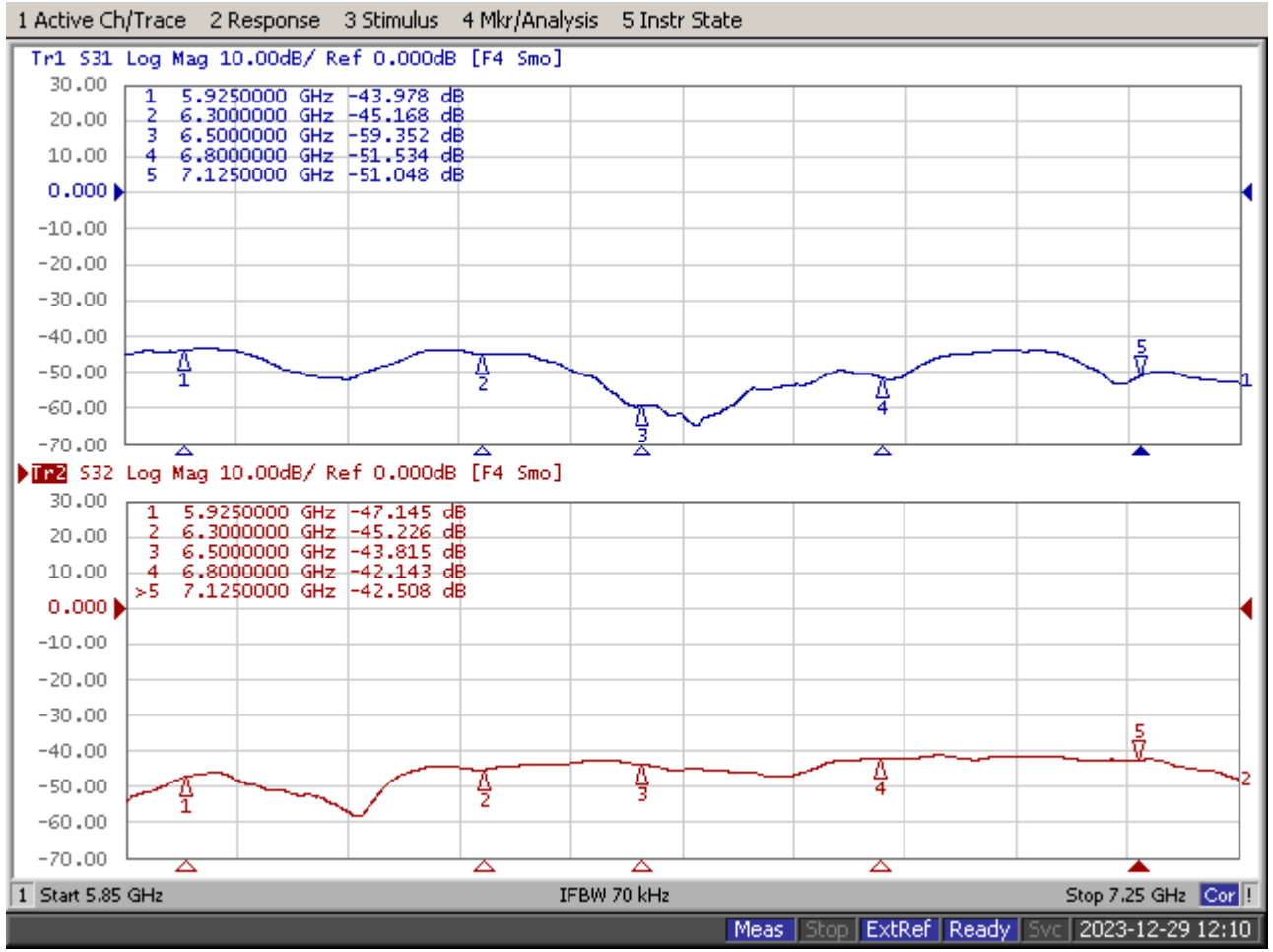
Isolation between 6 GHz Antennas



Port 1= 6G1	Port 2=6G2
Port 3= 6G5	

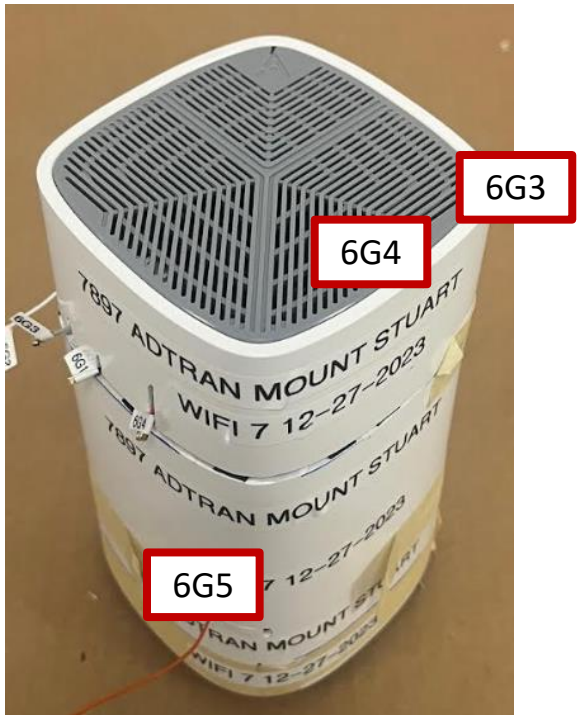


Isolation between 6 GHz Antennas

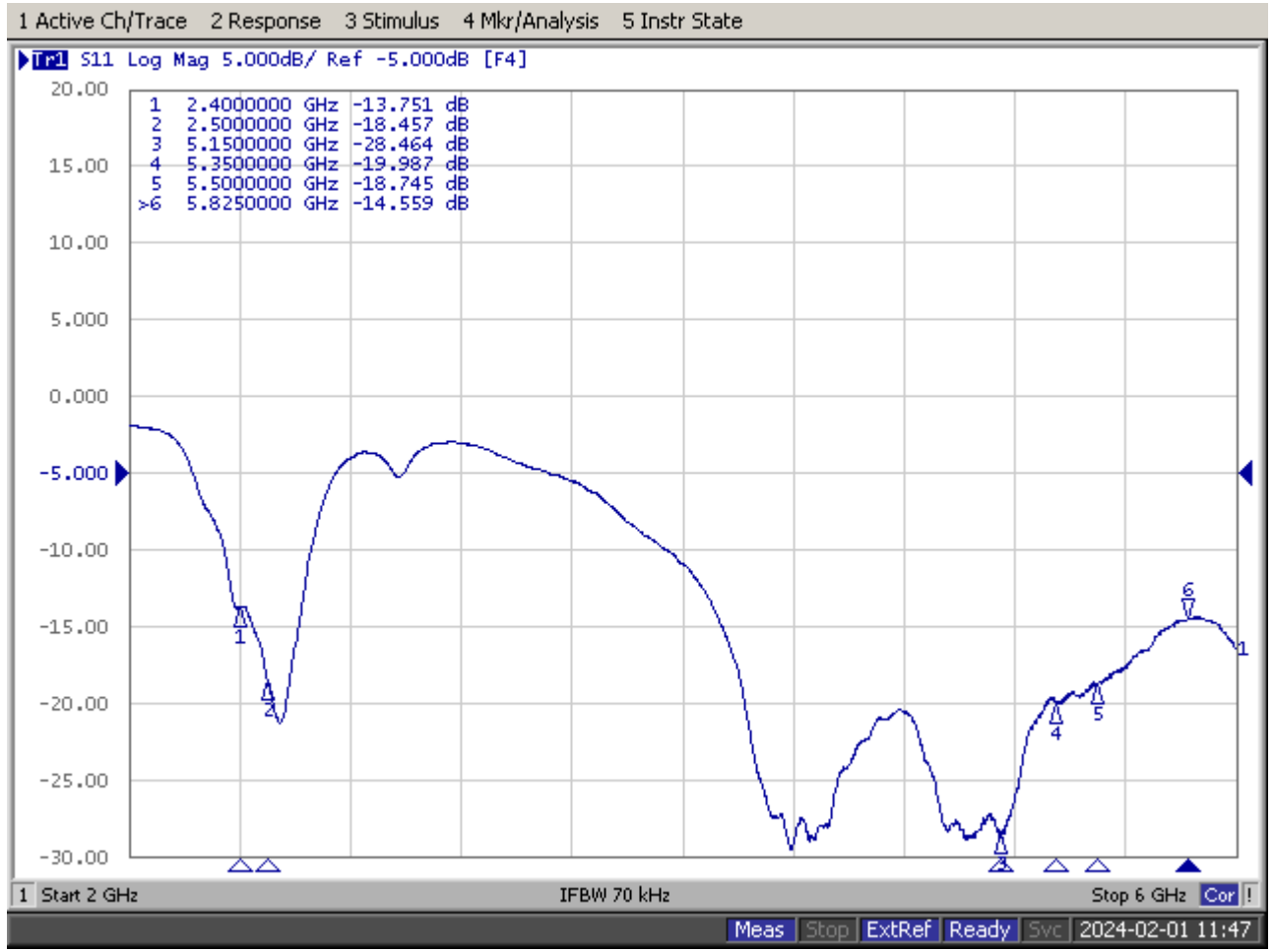


Port 1= 6G3 | Port 2=6G4

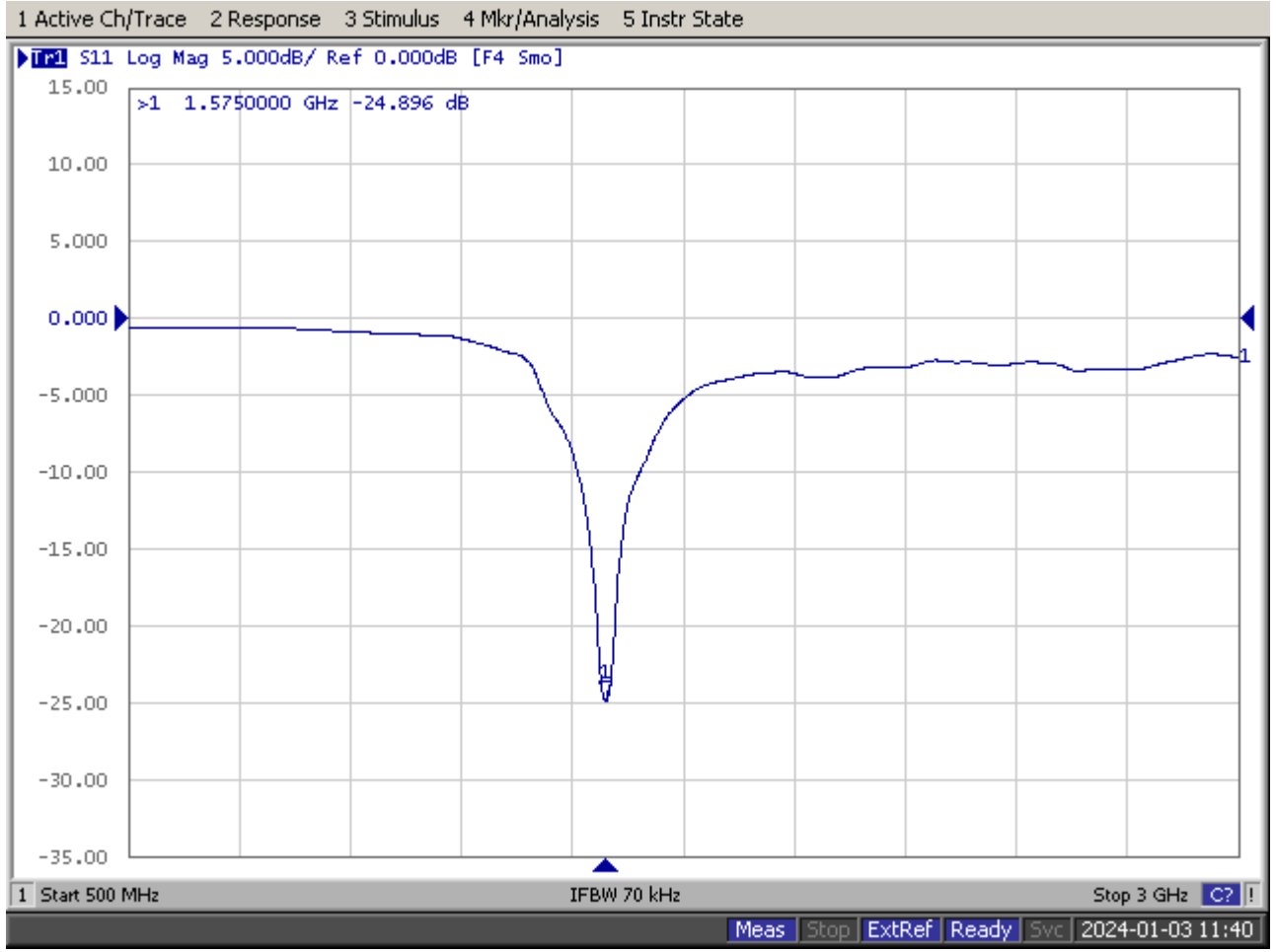
Port 3= 6G5



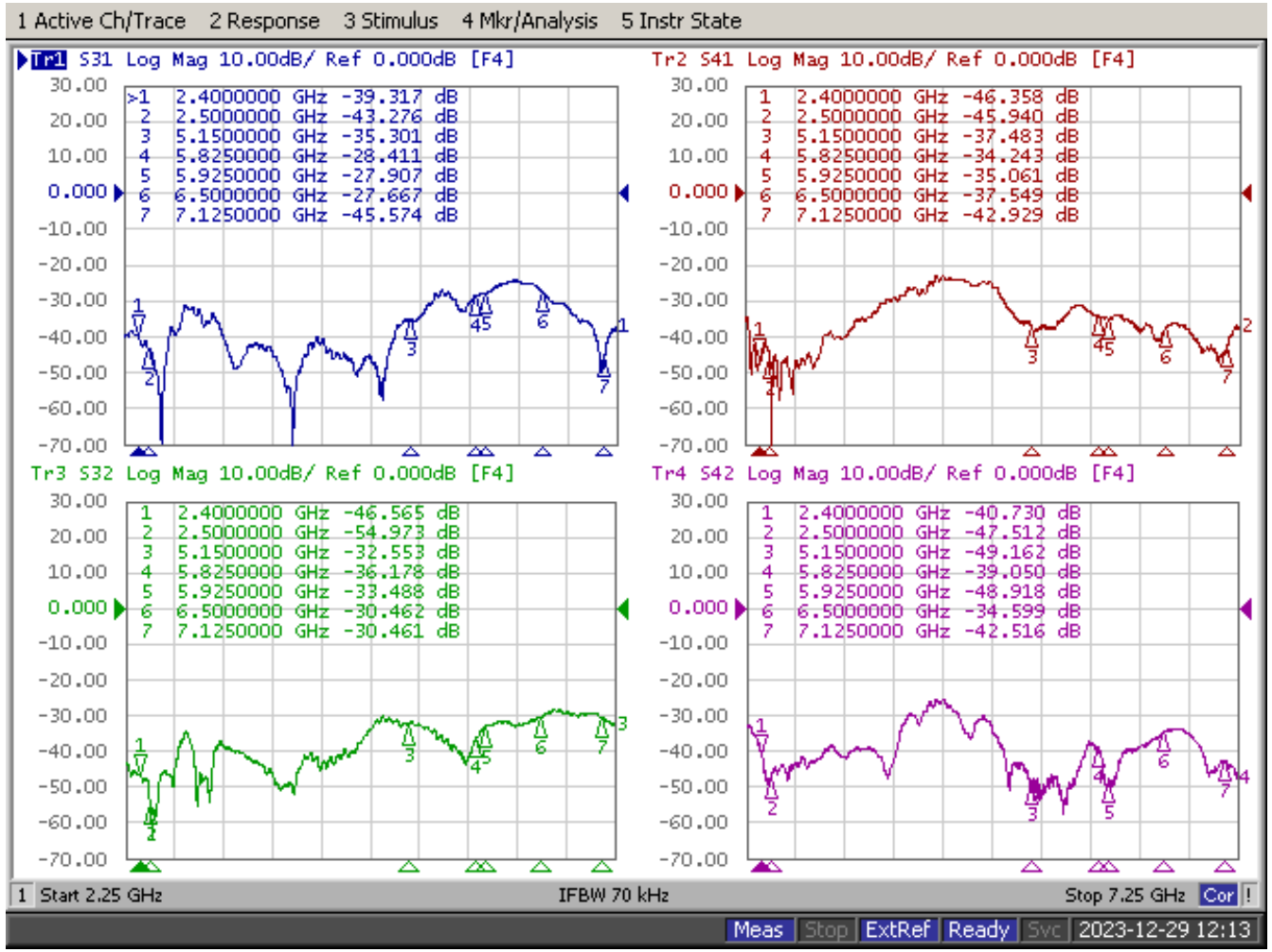
Return Loss of the SM-DFS Antenna



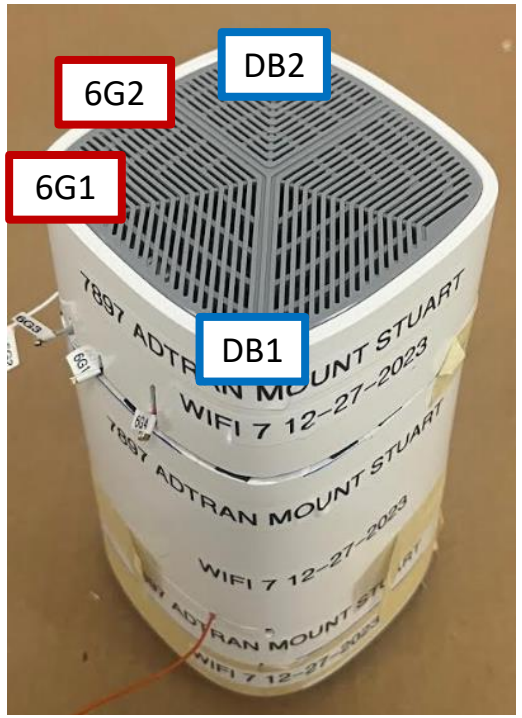
Return Loss of the GNSS Antenna



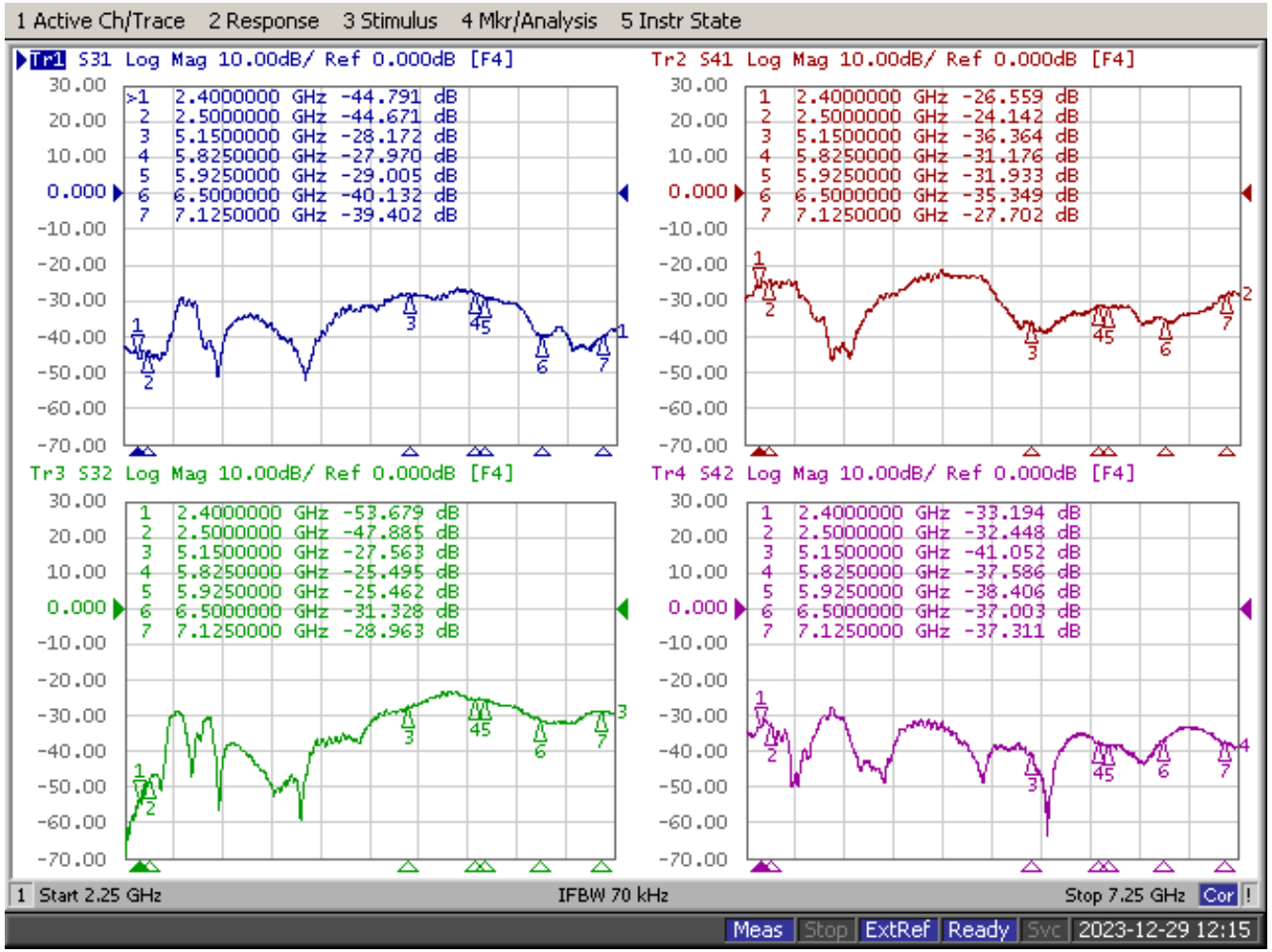
Isolation between DB and 6 GHz Antennas



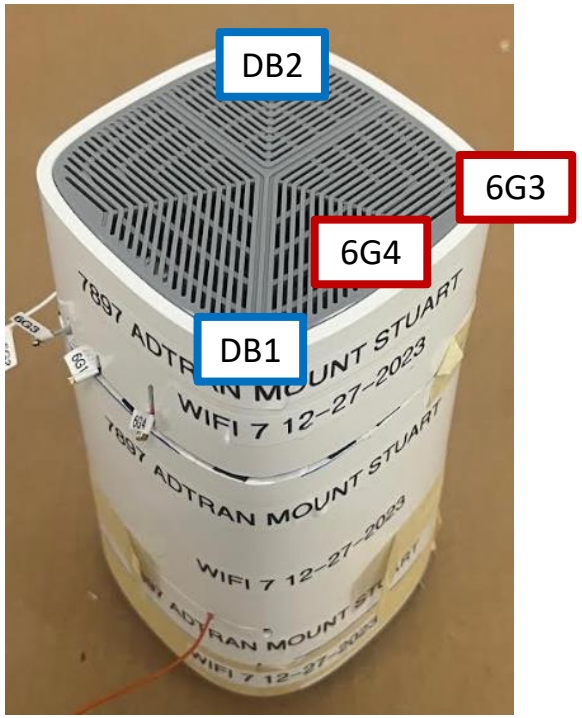
Port 1= DB1	Port 2= DB2
Port 3= 6G1	Port 4= 6G2



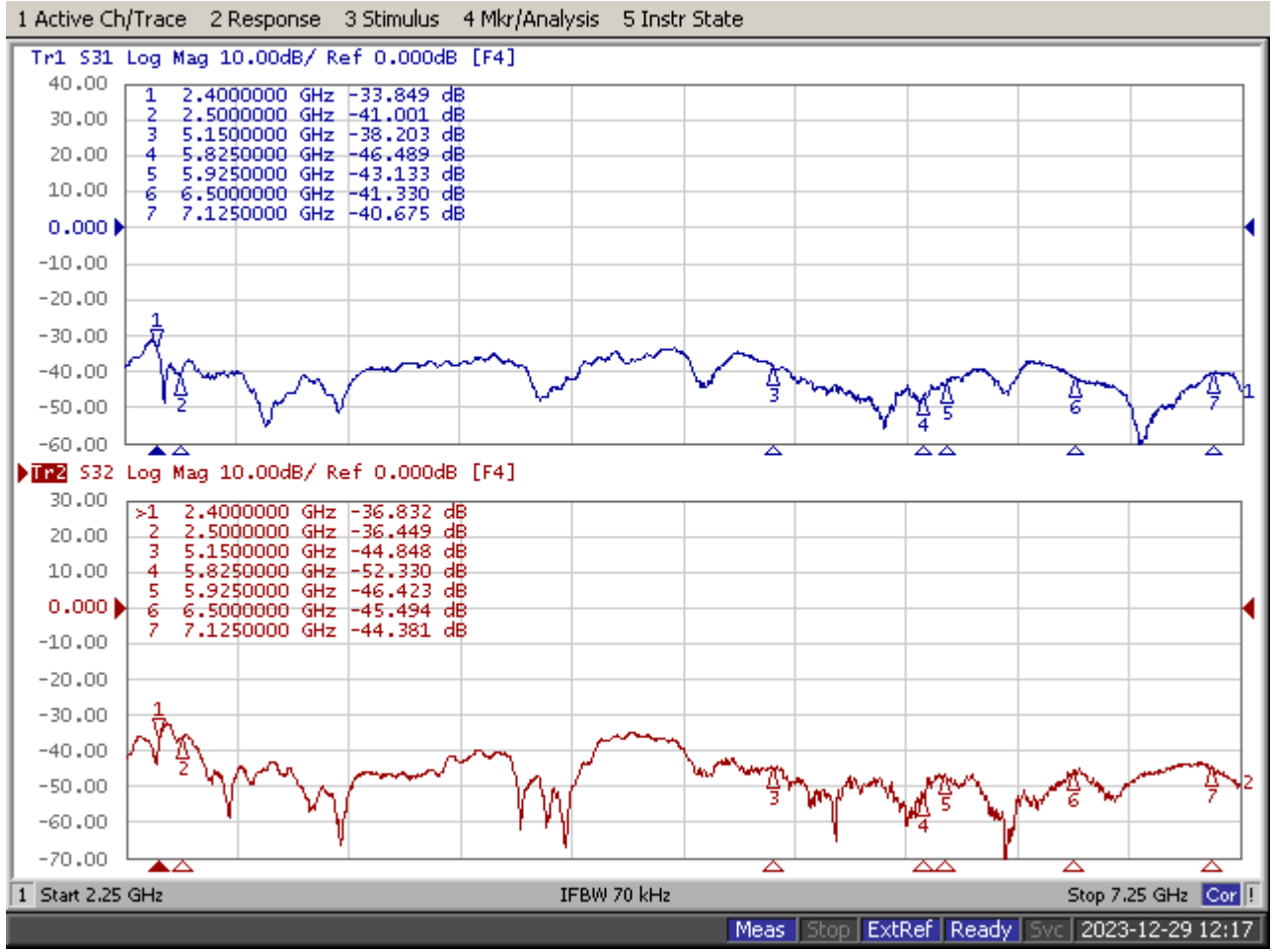
Isolation between DB and 6 GHz Antennas



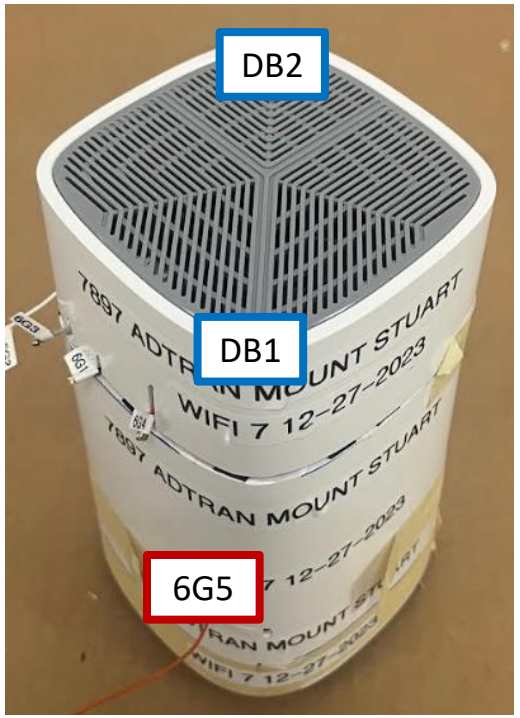
Port 1= DB1	Port 2= DB2
Port 3= 6G3	Port 4= 6G4



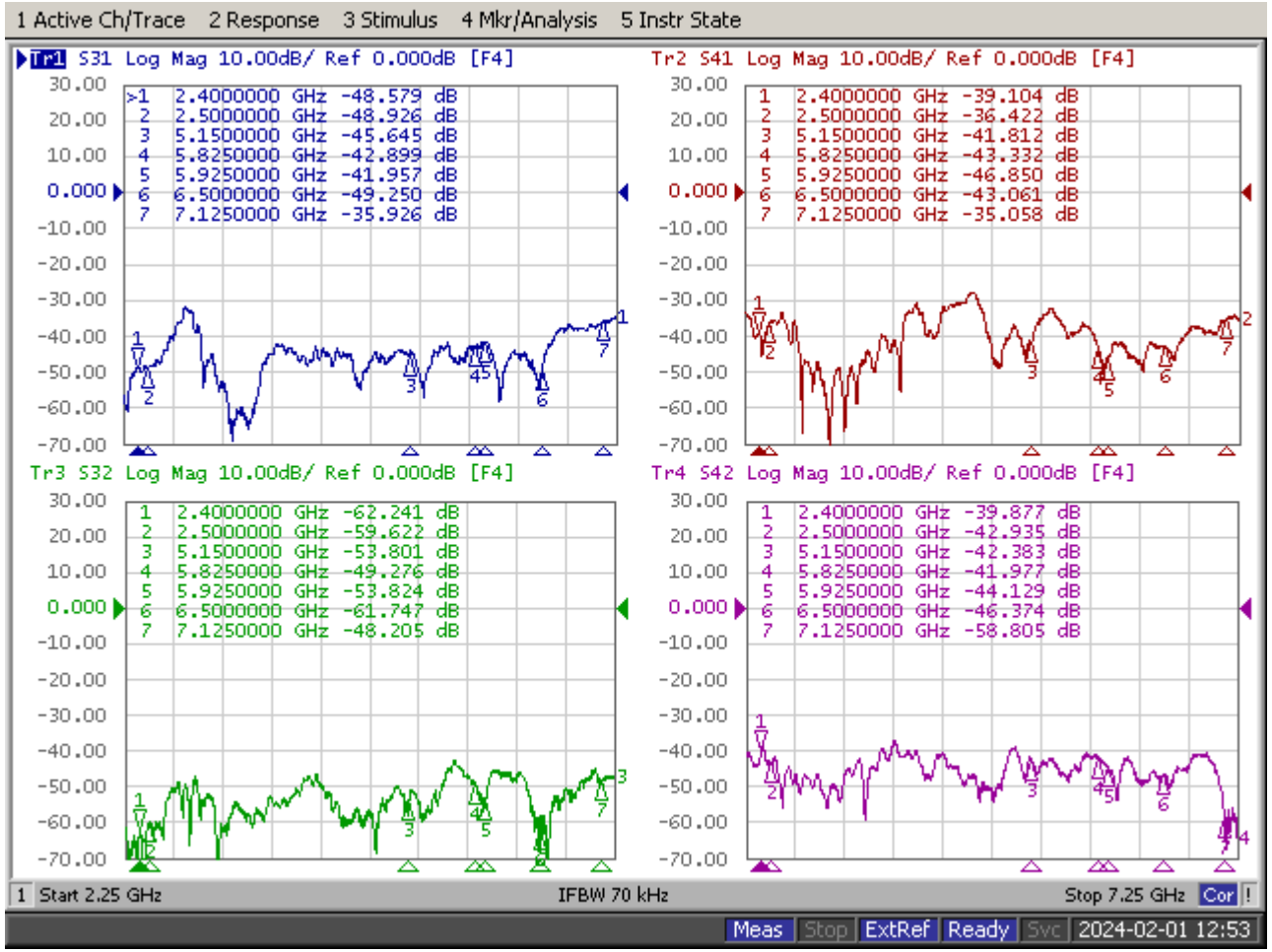
Isolation between DB and 6 GHz Antennas



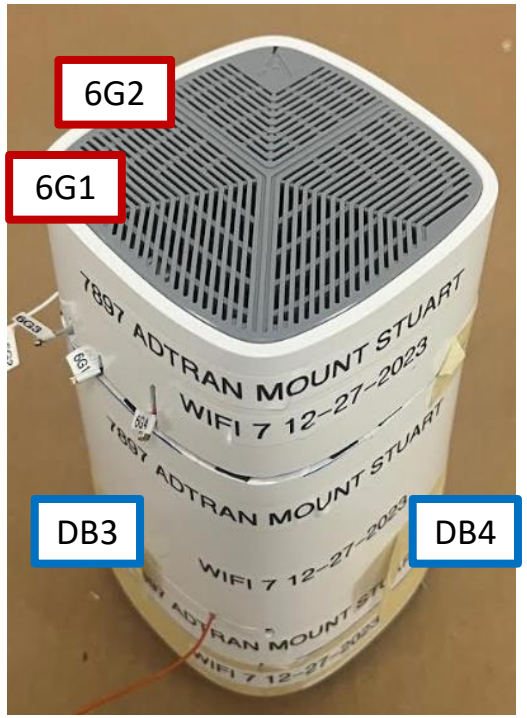
Port 1= DB1	Port 2= DB2
Port 3= 6G5	



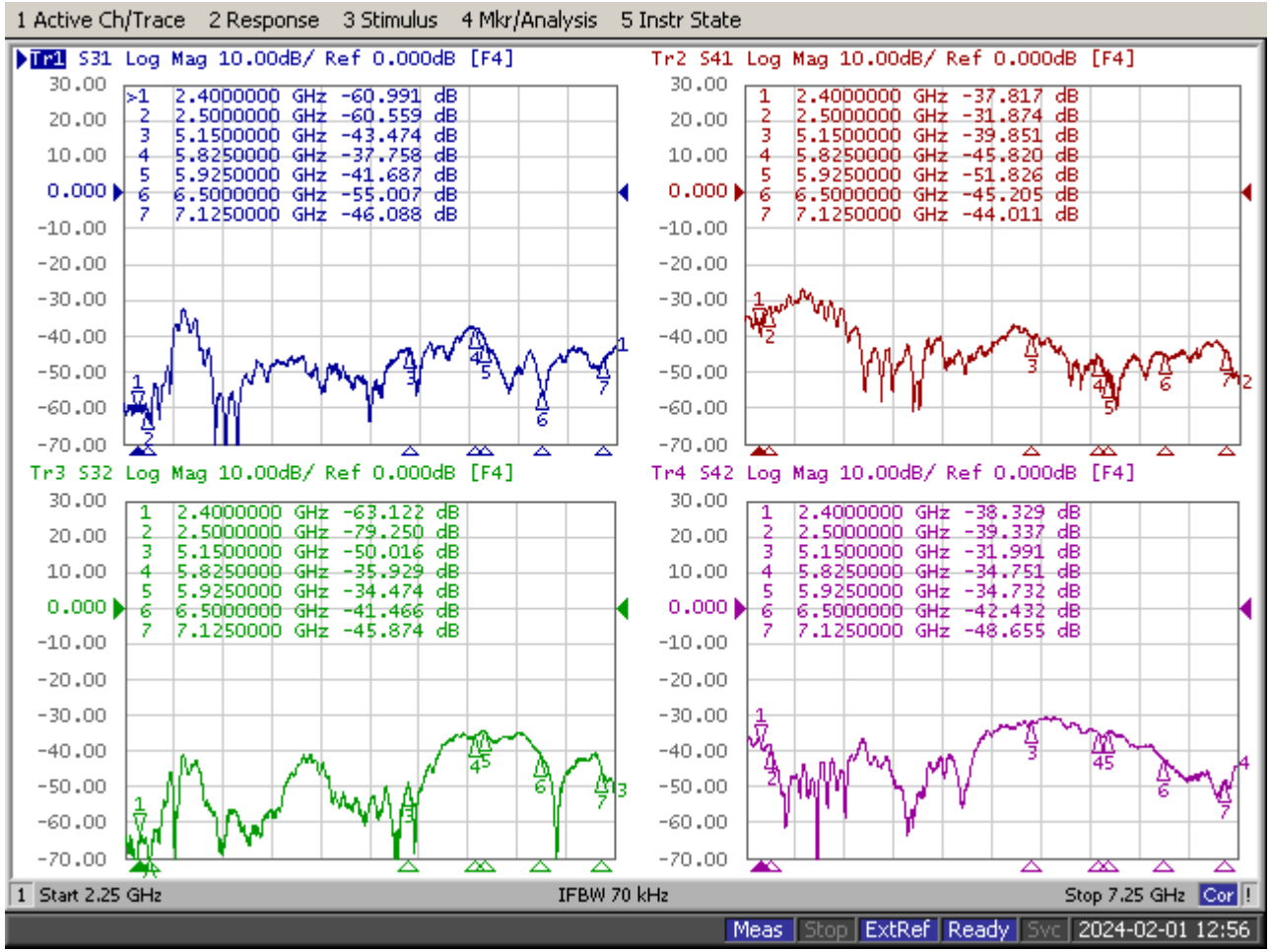
Isolation between DB and 6 GHz Antennas



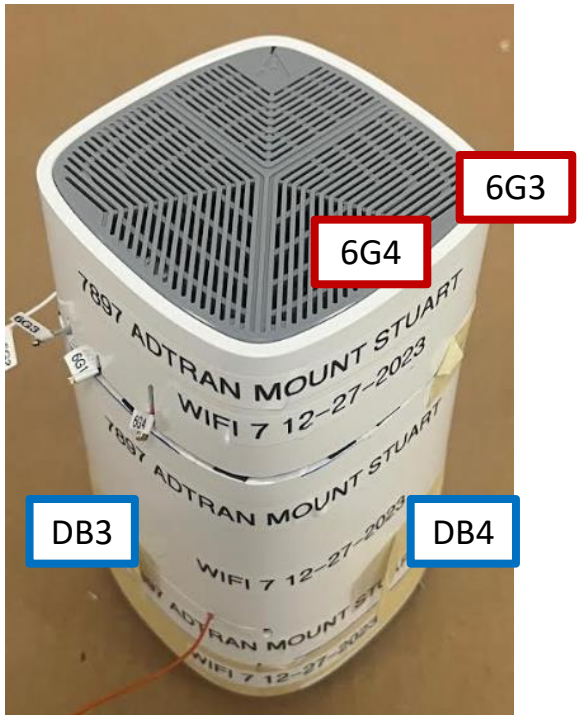
Port 1= DB3	Port 2= DB4
Port 3= 6G1	Port 4= 6G2



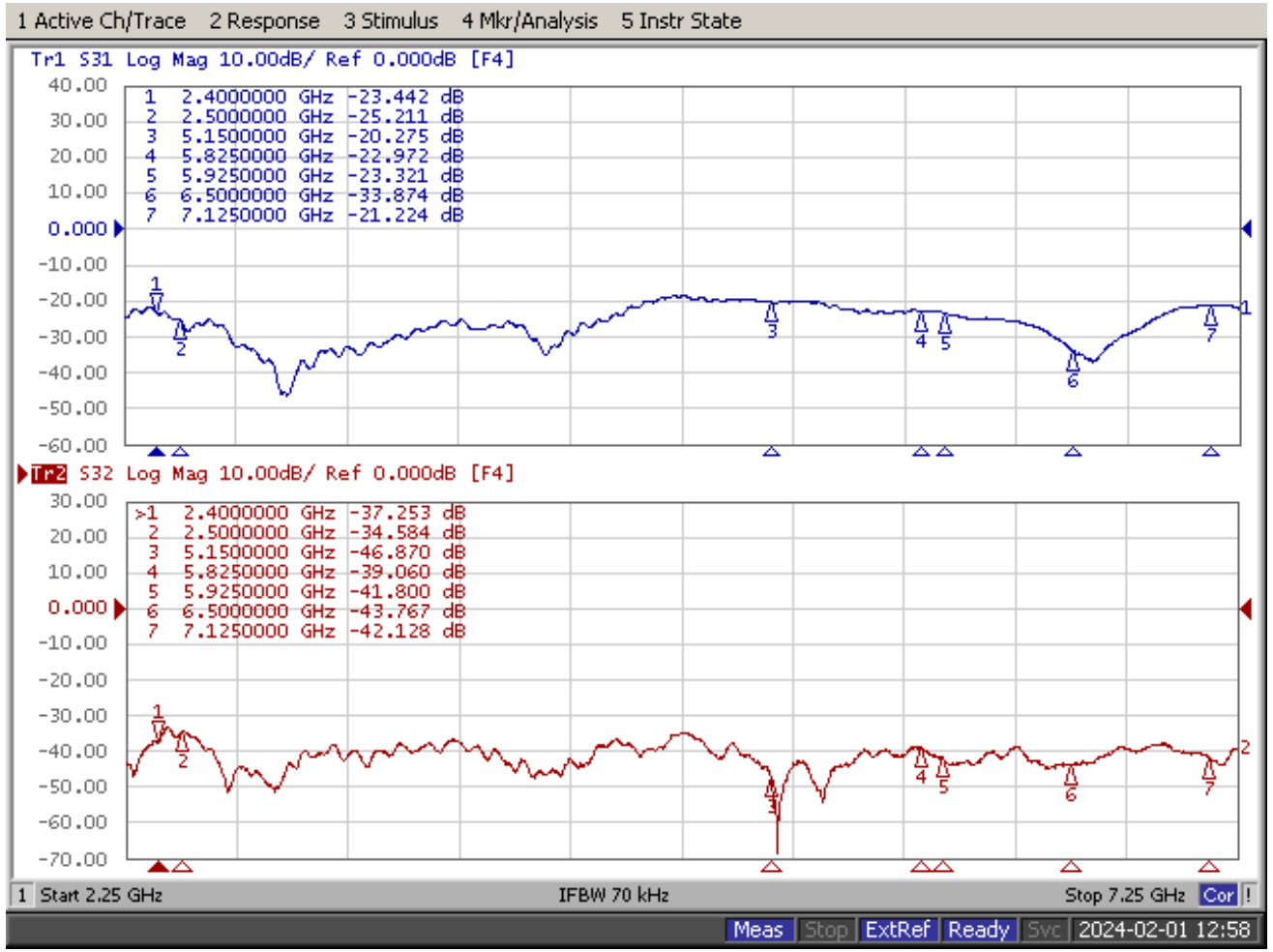
Isolation between DB and 6 GHz Antennas



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

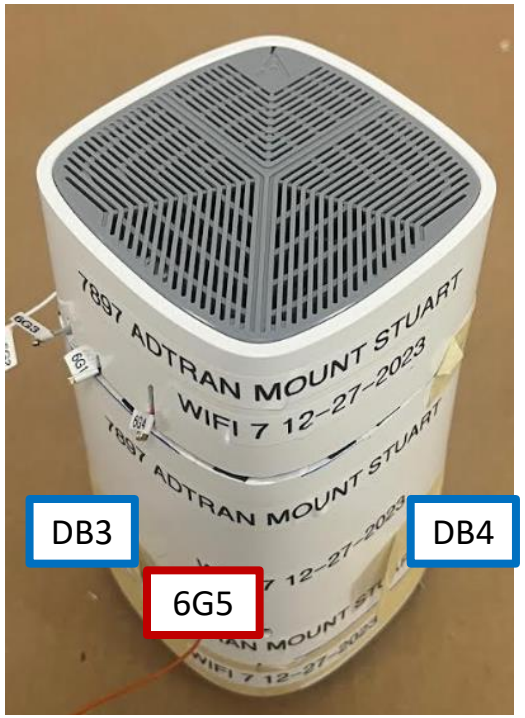


Isolation between DB and 6 GHz Antennas

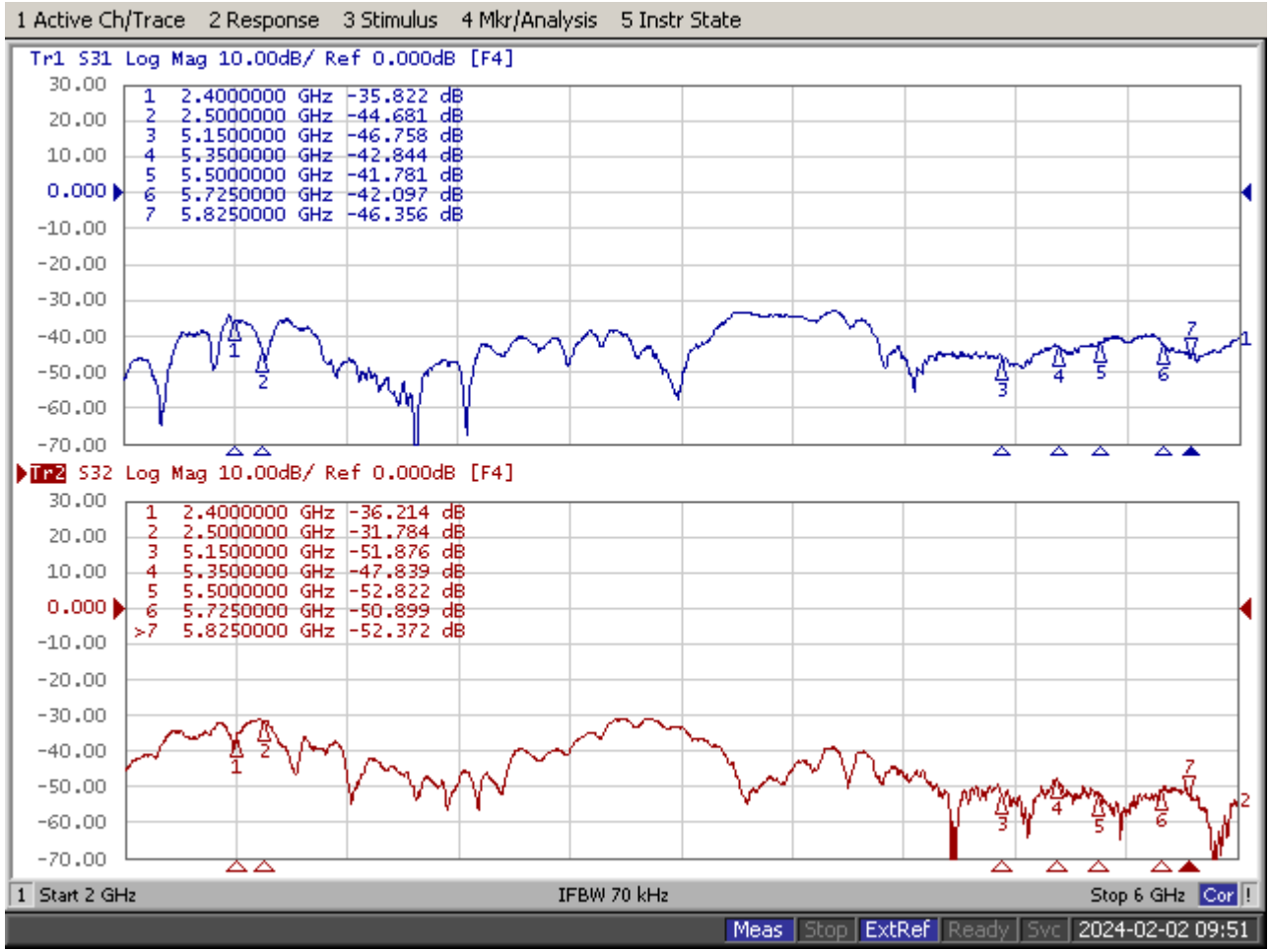


Port 1= DB3 | Port 2= DB4

Port 3= 6G5

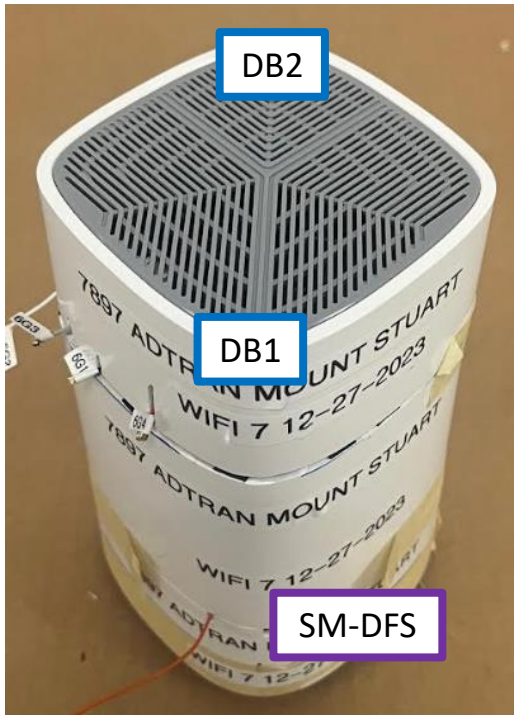


Isolation between DB, SM and DFS Antennas

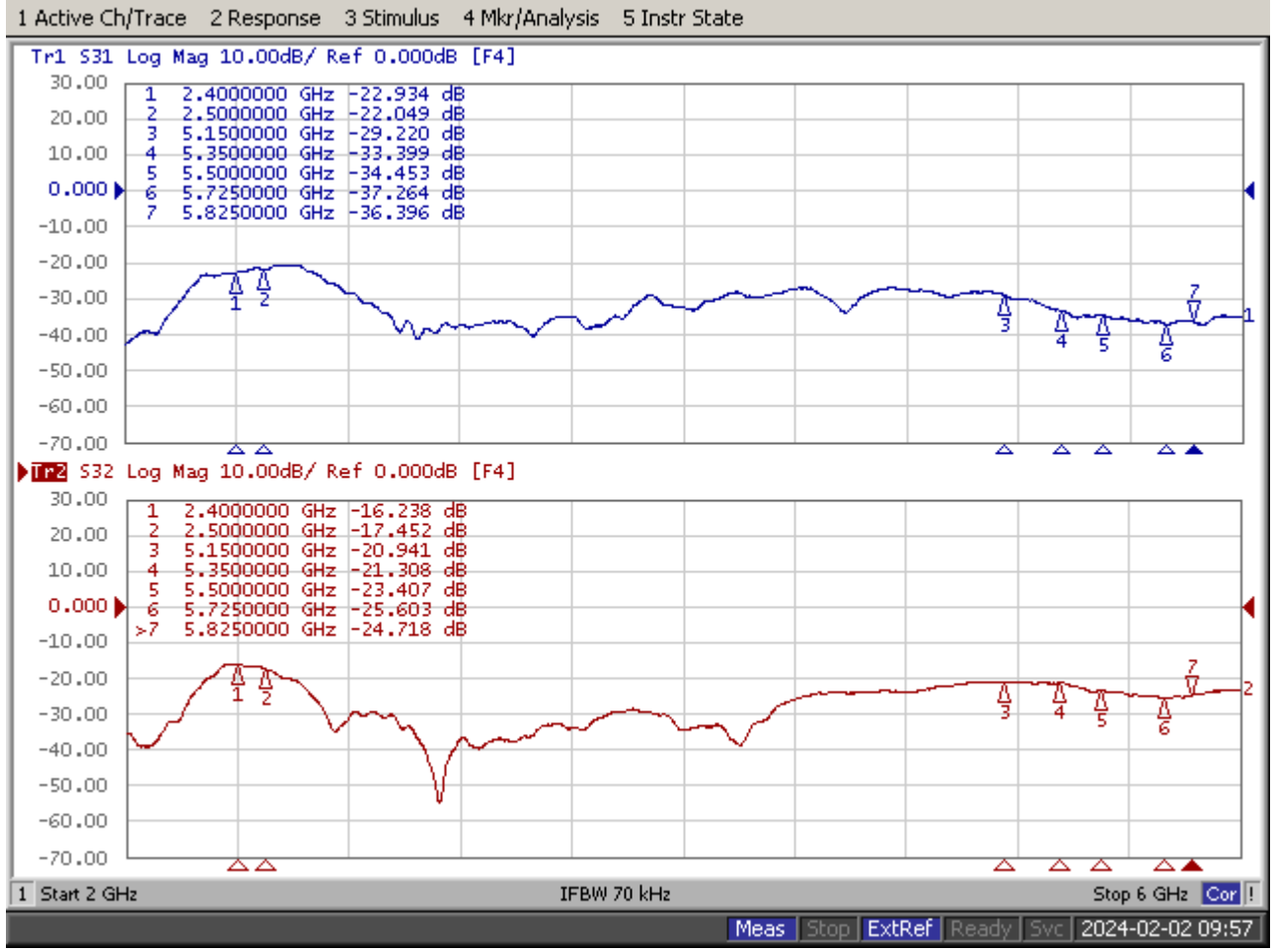


Port 1= DB1 | Port 2= DB2

Port 3= SM-DFS

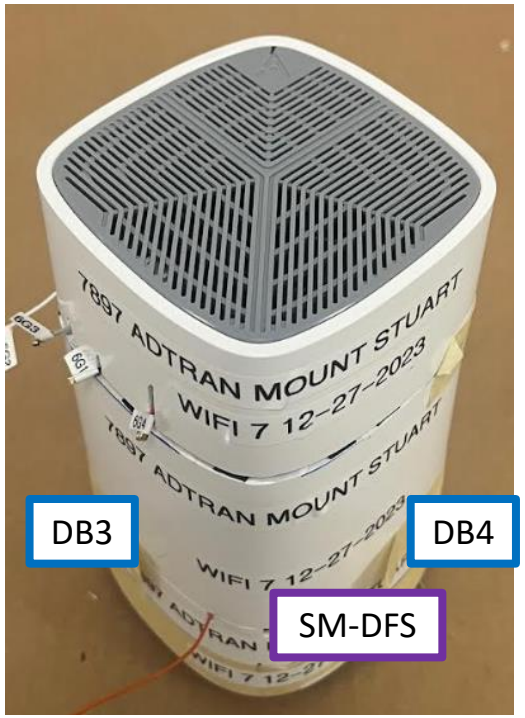


Isolation between DB, SM and DFS Antennas

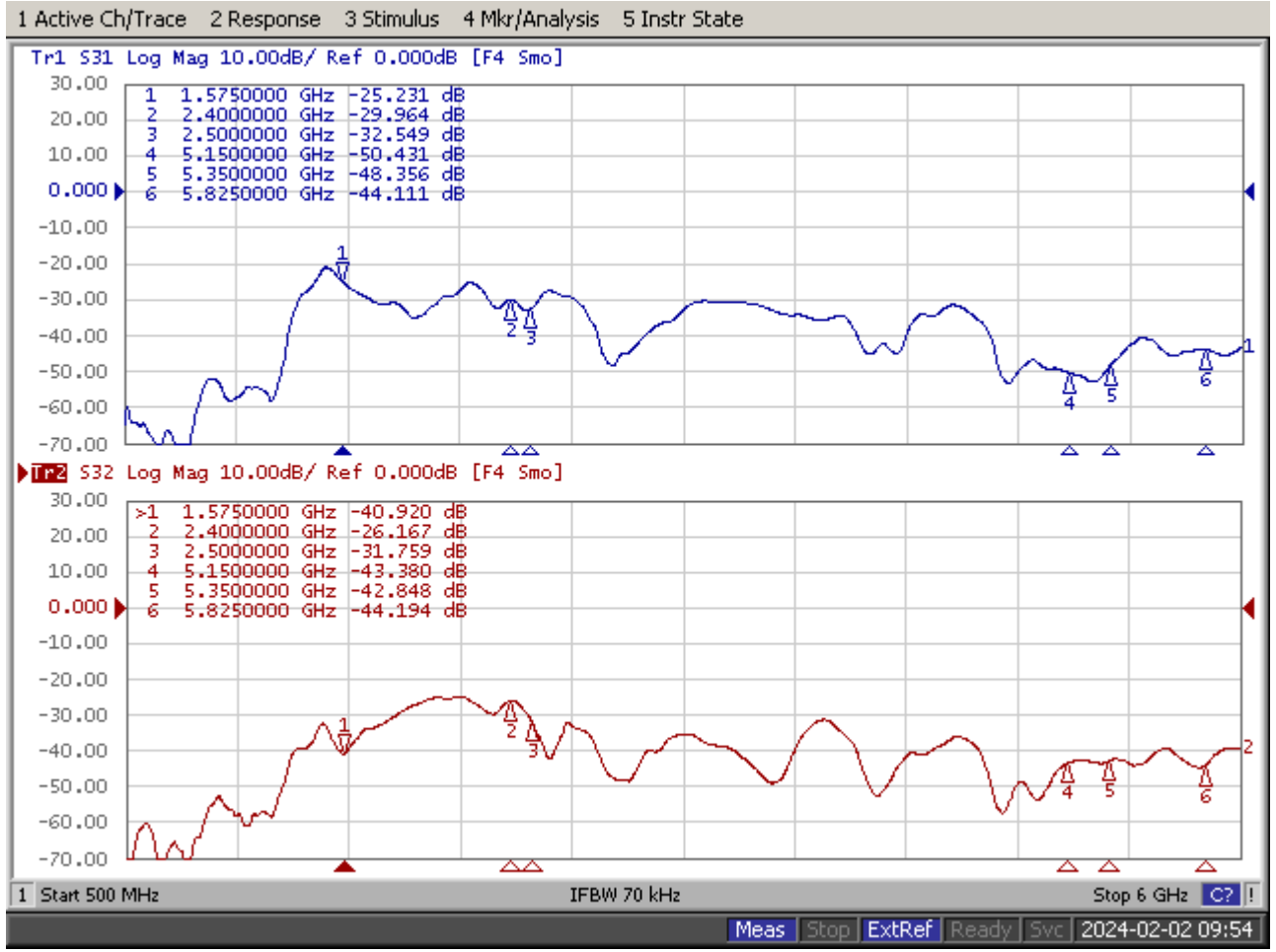


Port 1= DB3 | Port 2= DB4

Port 3= SM-DFS

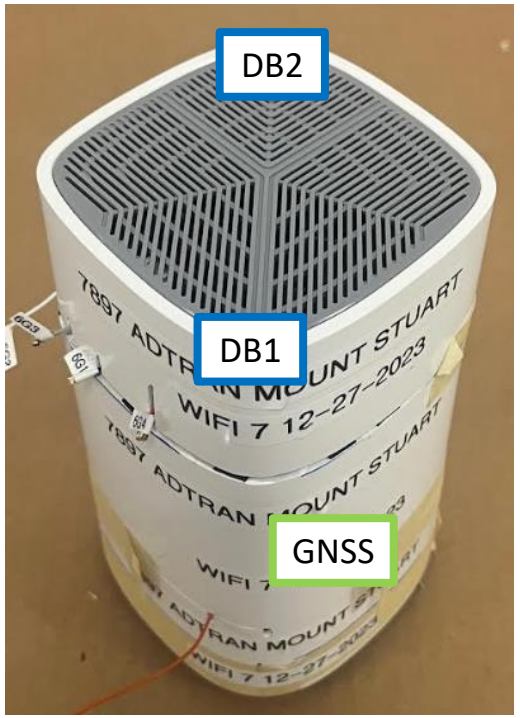


Isolation between DB and GNSS Antennas

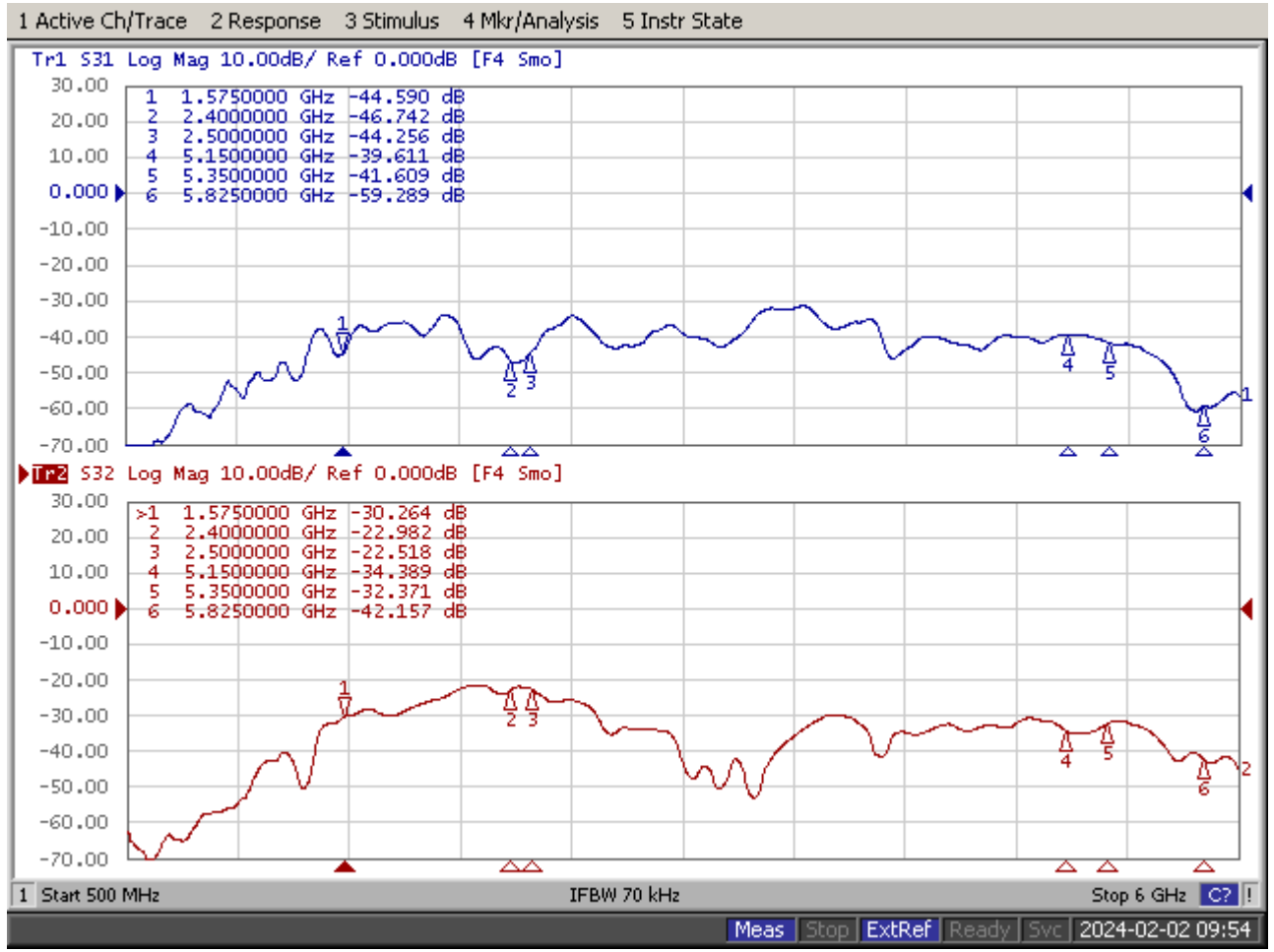


Port 1= DB1 | Port 2= DB2

Port 3=GNSS

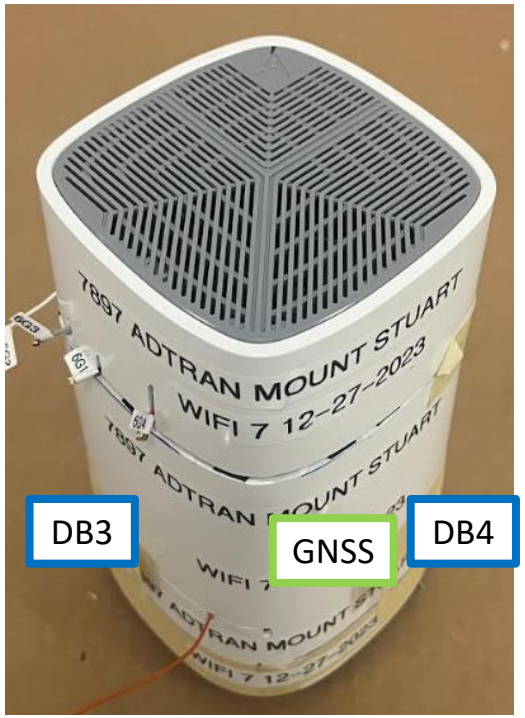


Isolation between DB and GNSS Antennas

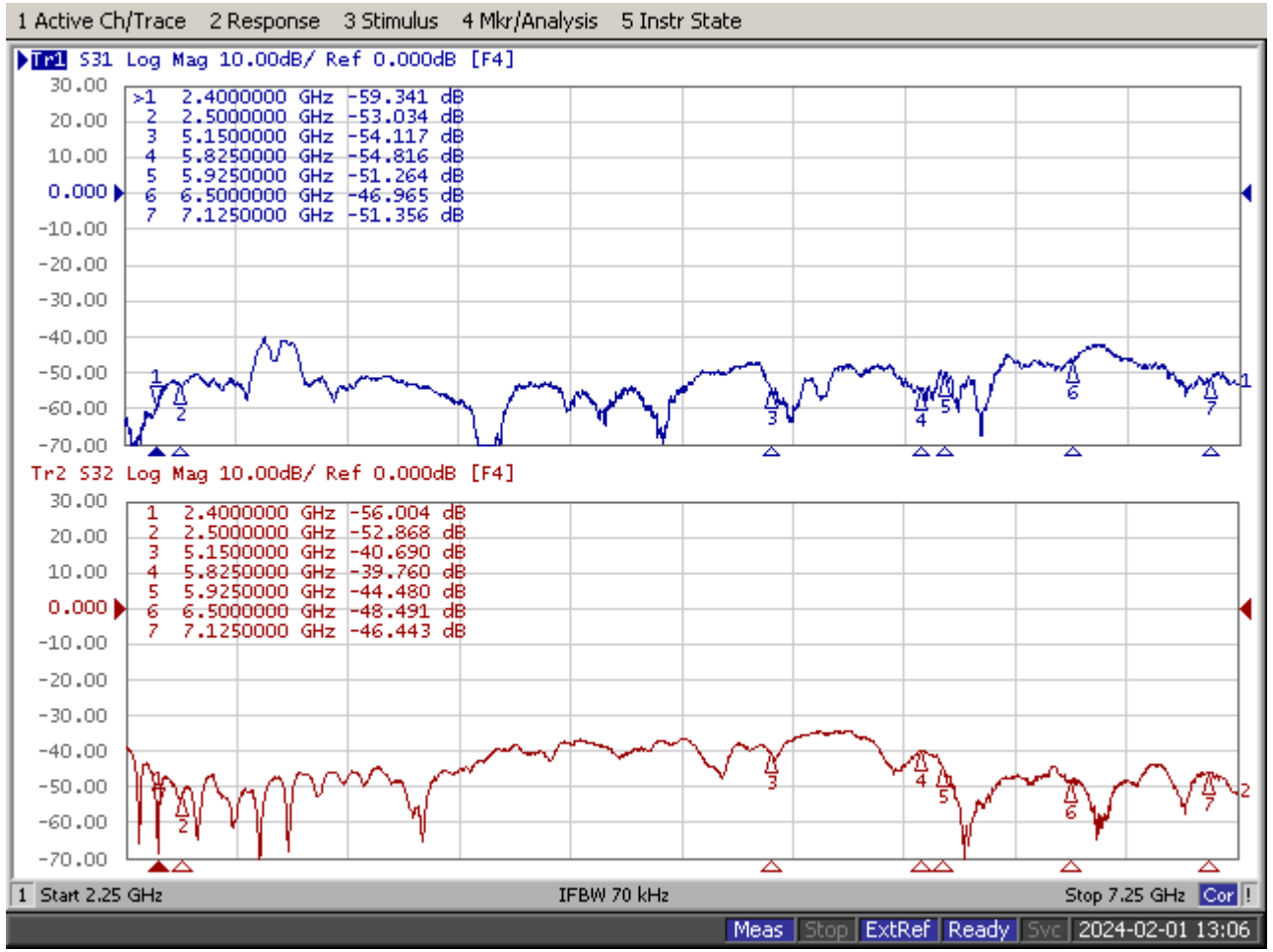


Port 1= DB3 | Port 2= DB4

Port 3=GNSS

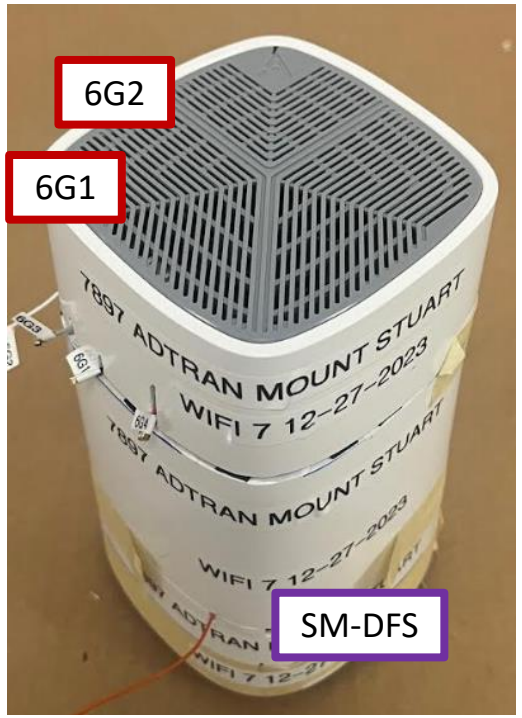


Isolation between 6 GHz, SM and DFS Antennas

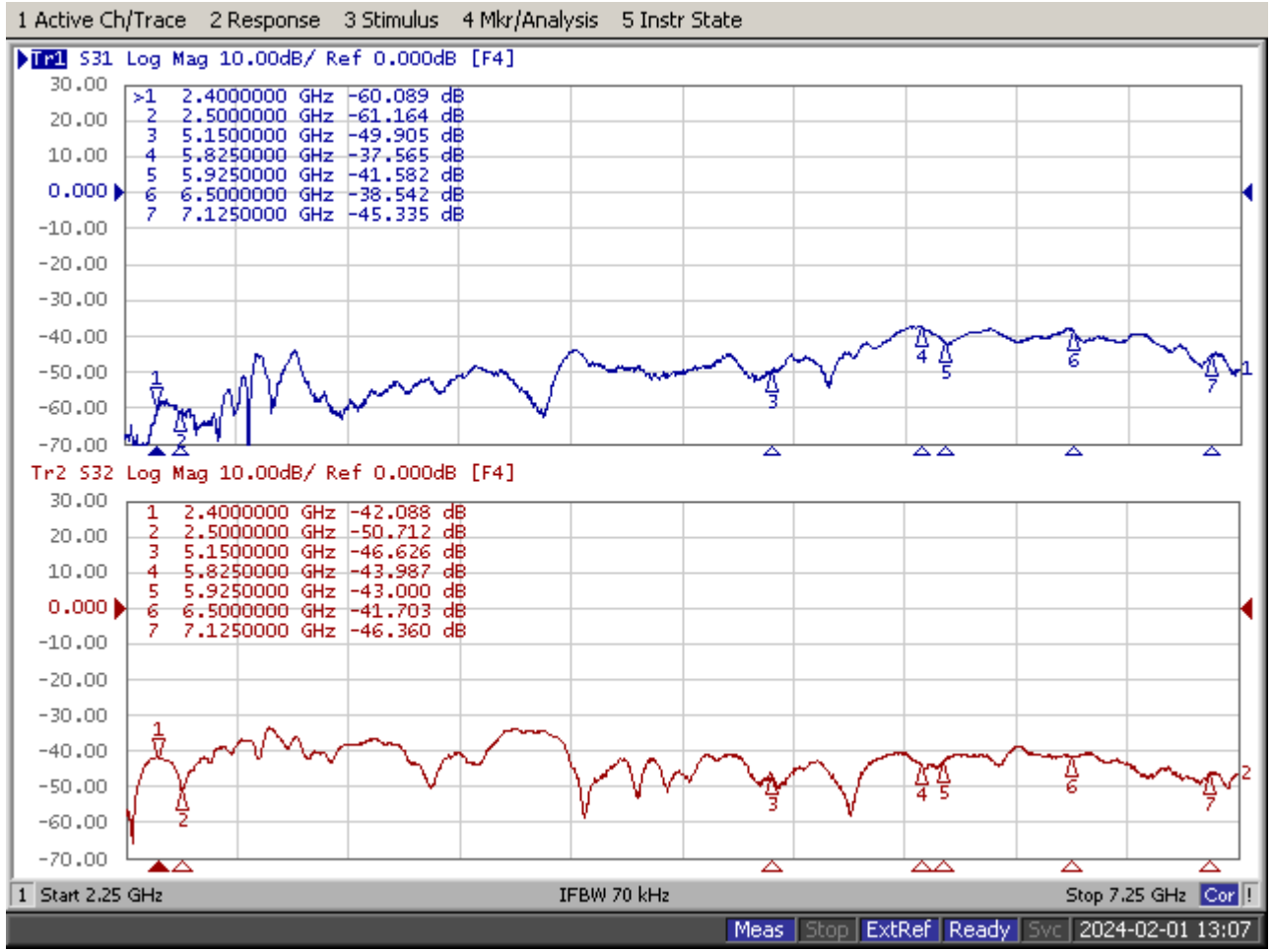


Port 1= 6G1 | Port 2= 6G2

Port 3= SM-DFS

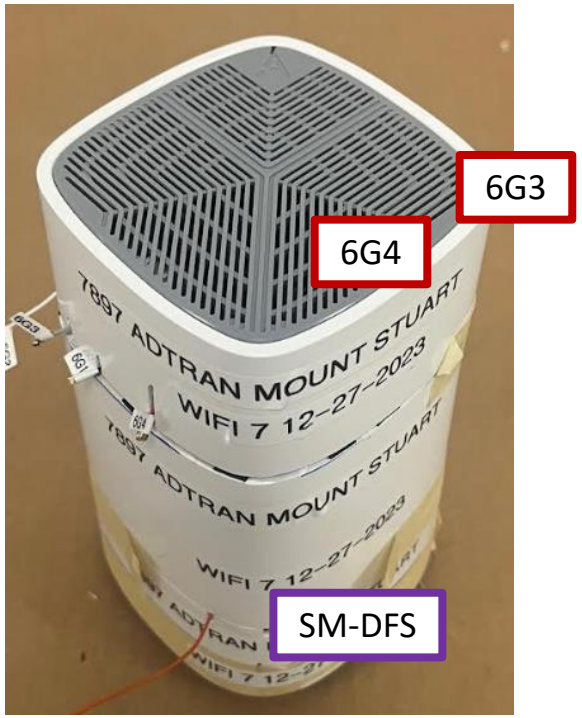


Isolation between 6 GHz, SM and DFS Antennas

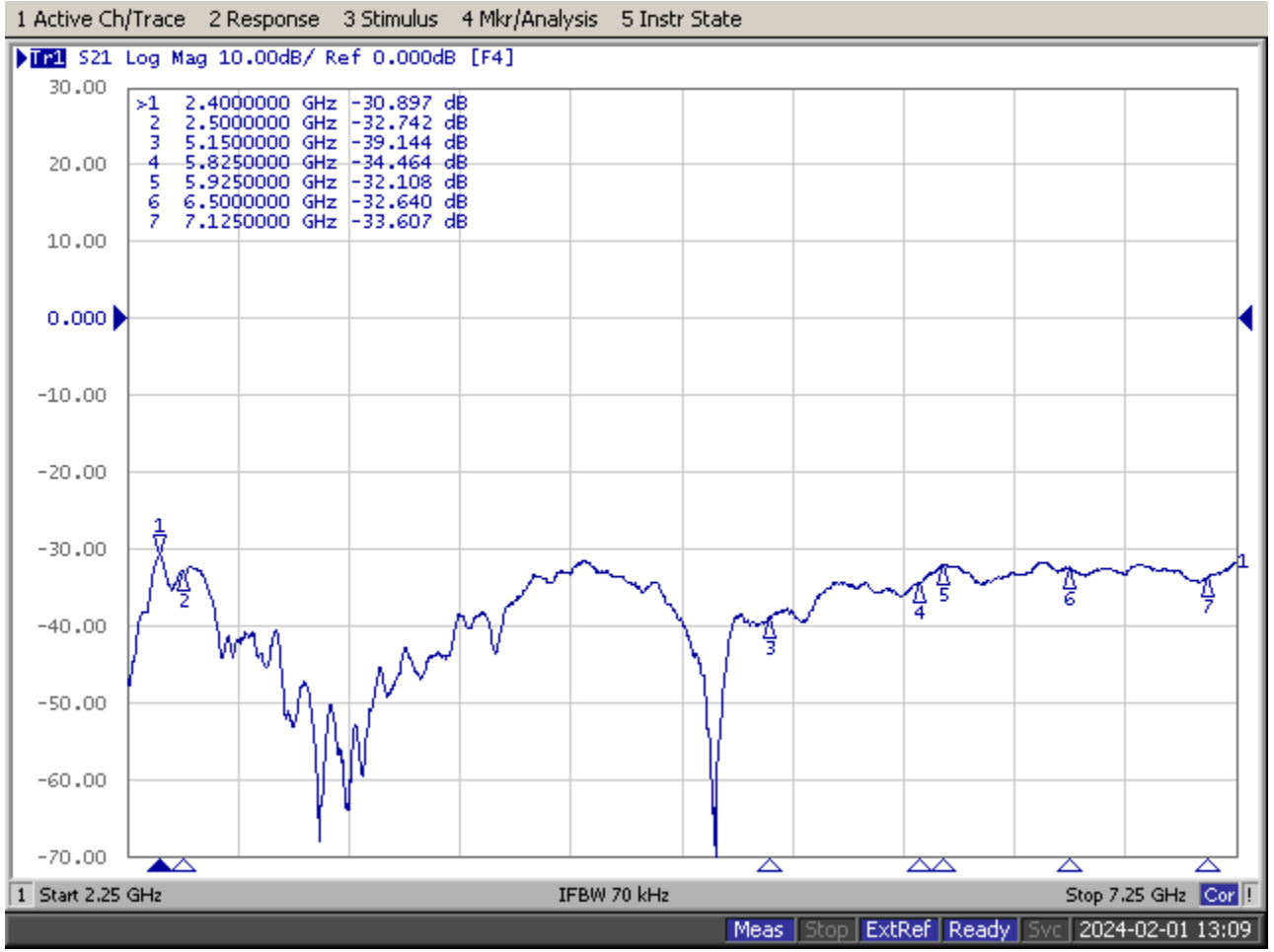


Port 1= 6G3 | Port 2= 6G4

Port 3= SM-DFS

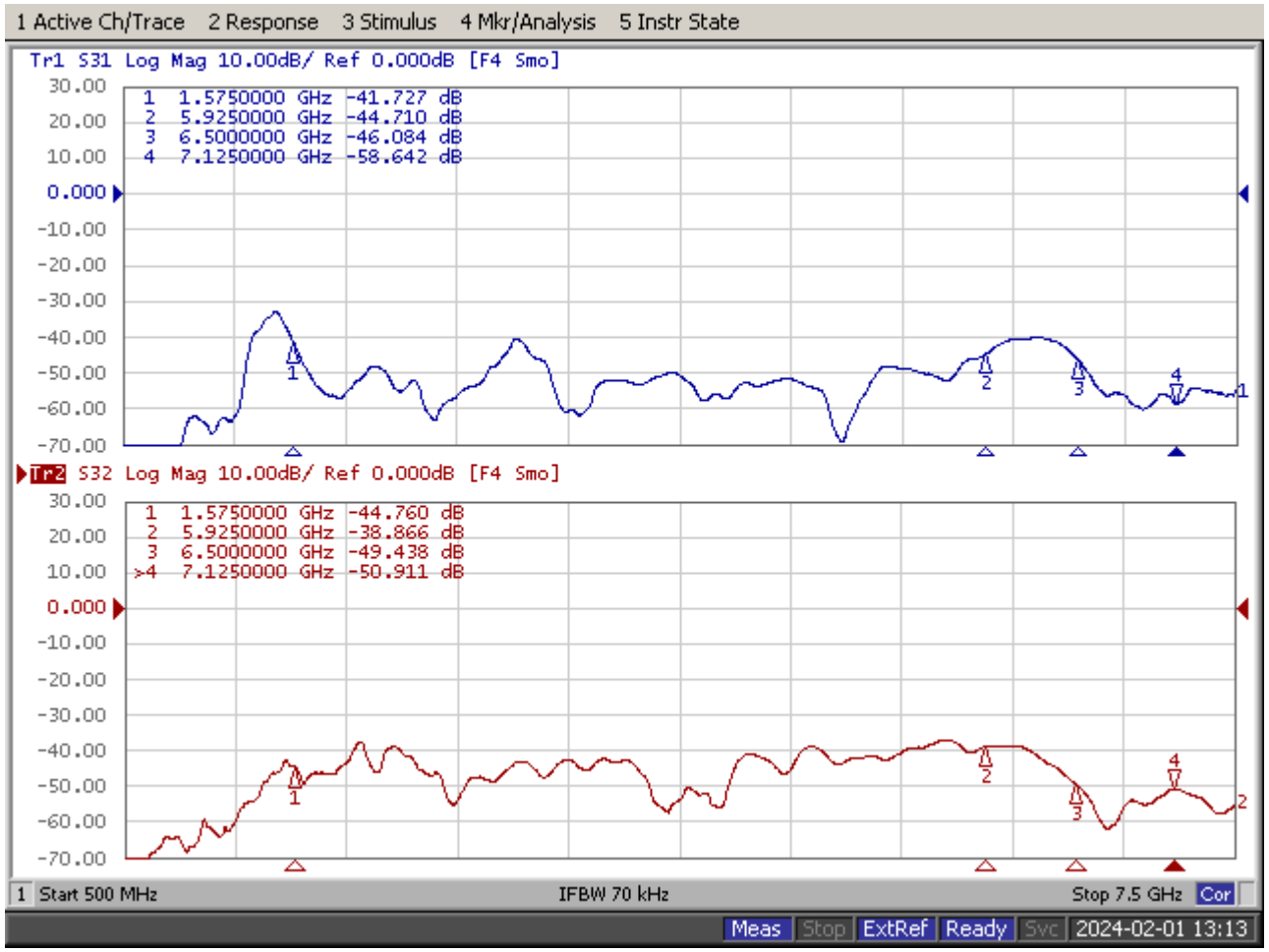


Isolation between 6 GHz, SM and DFS Antennas



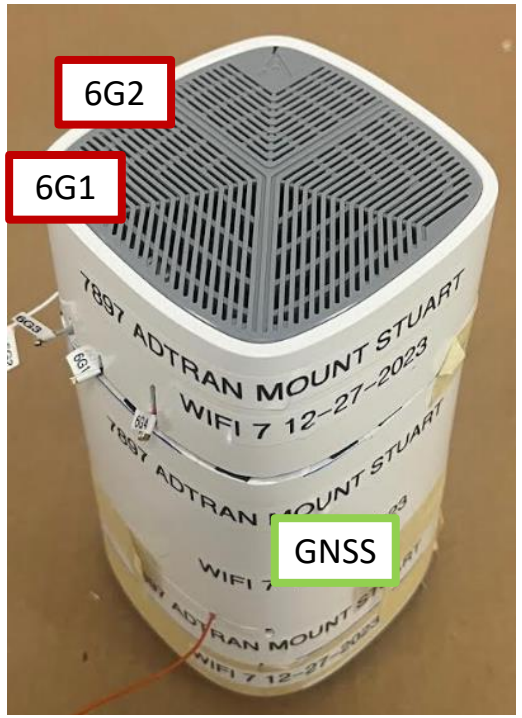
Port 1= 6G5 | Port 2= SM-DFS

Isolation between 6 GHz and GNSS Antennas

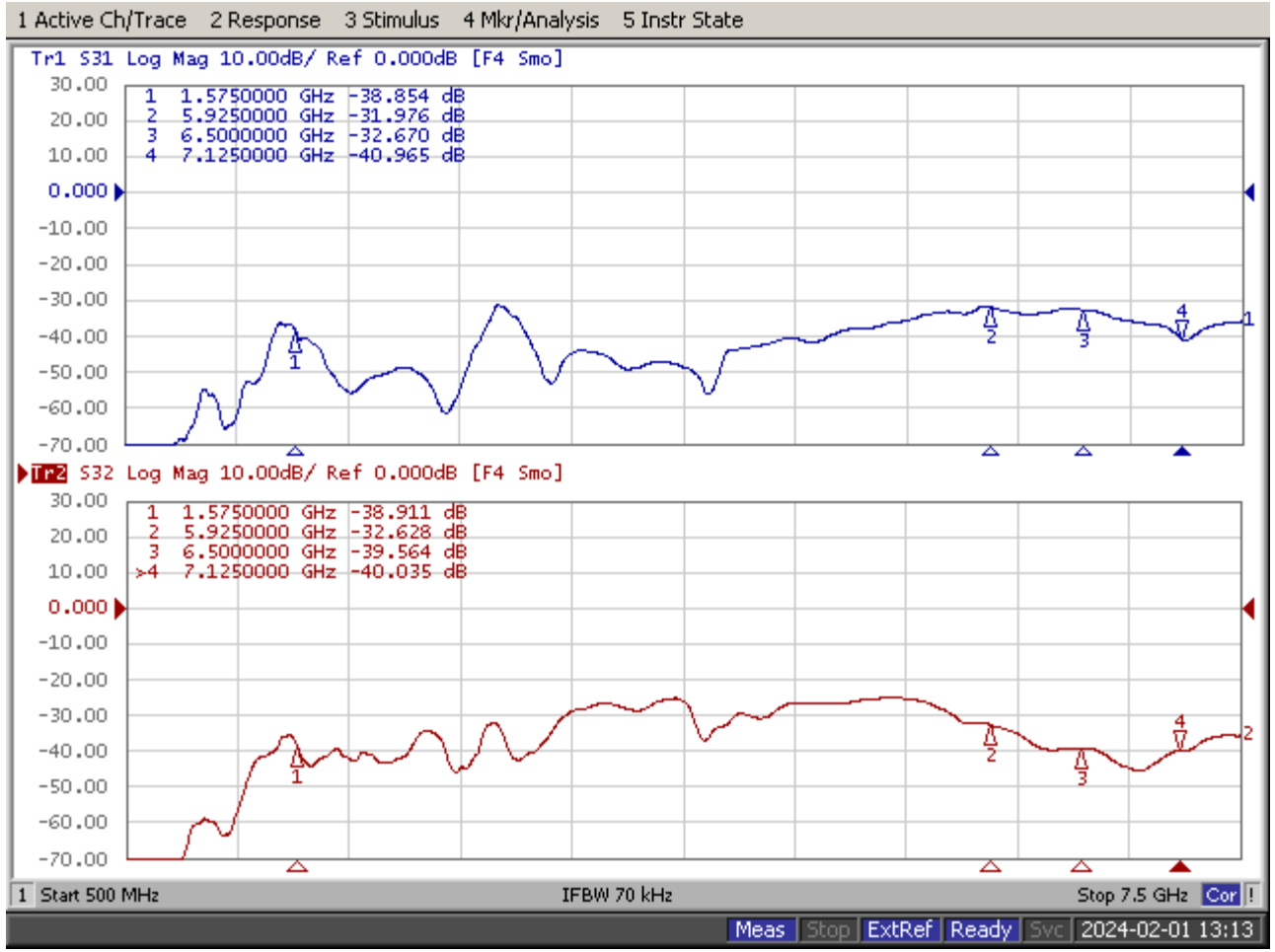


Port 1= 6G1 | Port 2= 6G2

Port 3=GNSS

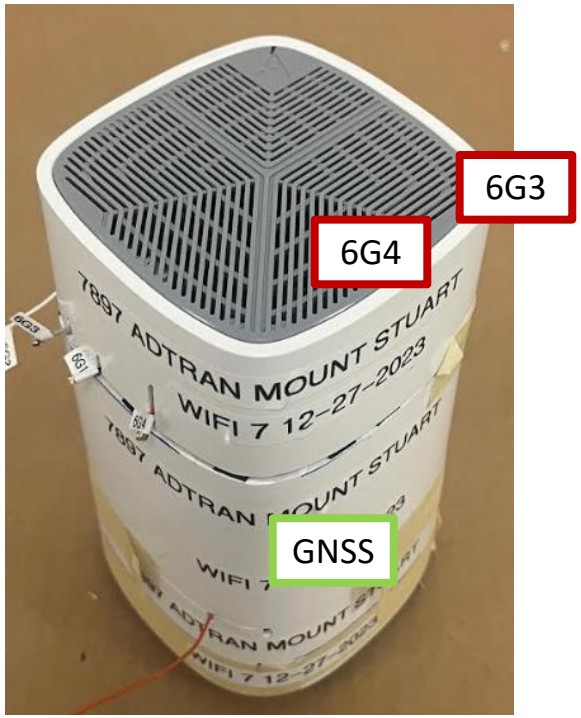


Isolation between 6 GHz and GNSS Antennas

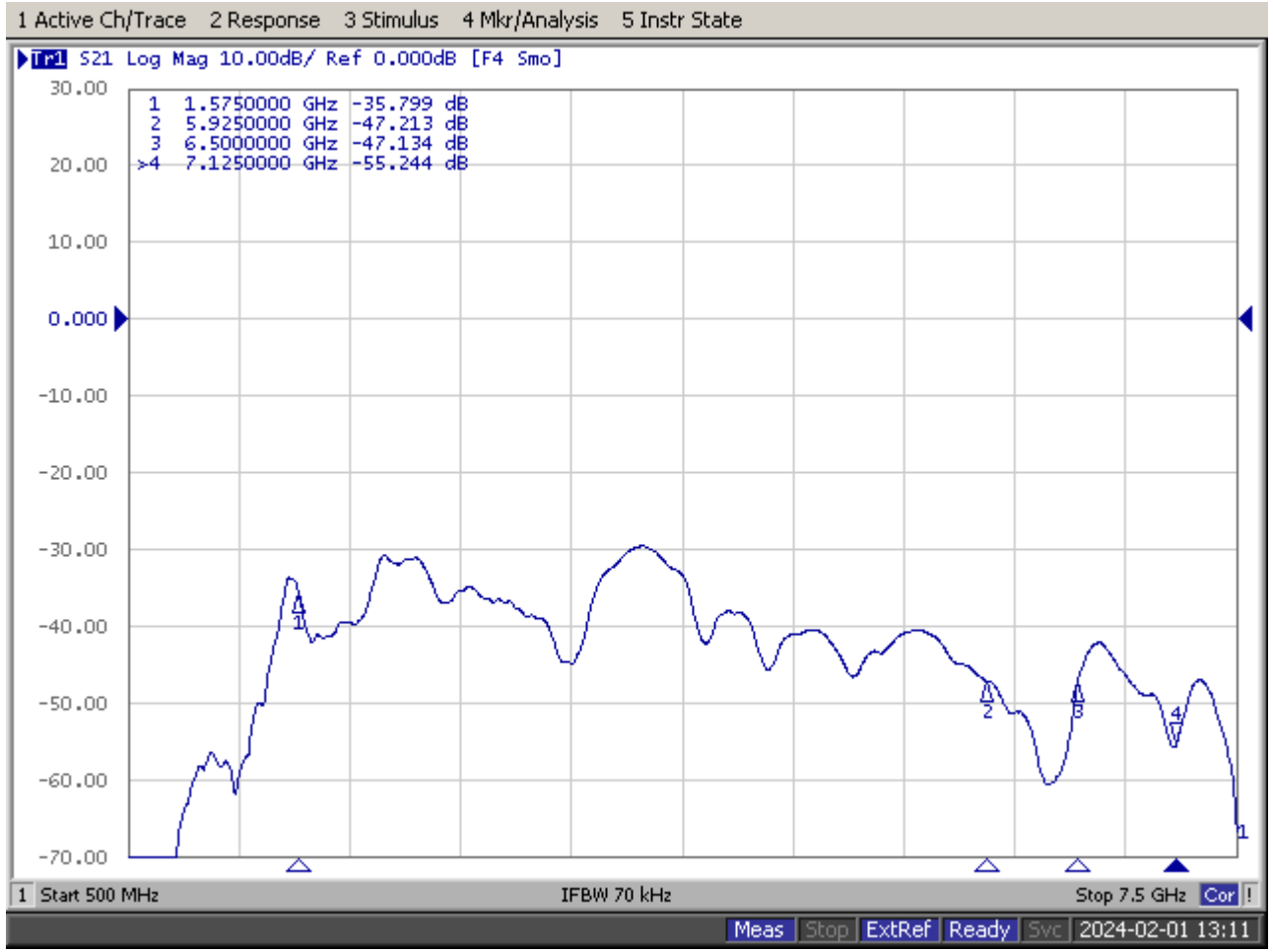


Port 1= 6G3 | Port 2= 6G4

Port 3=GNSS

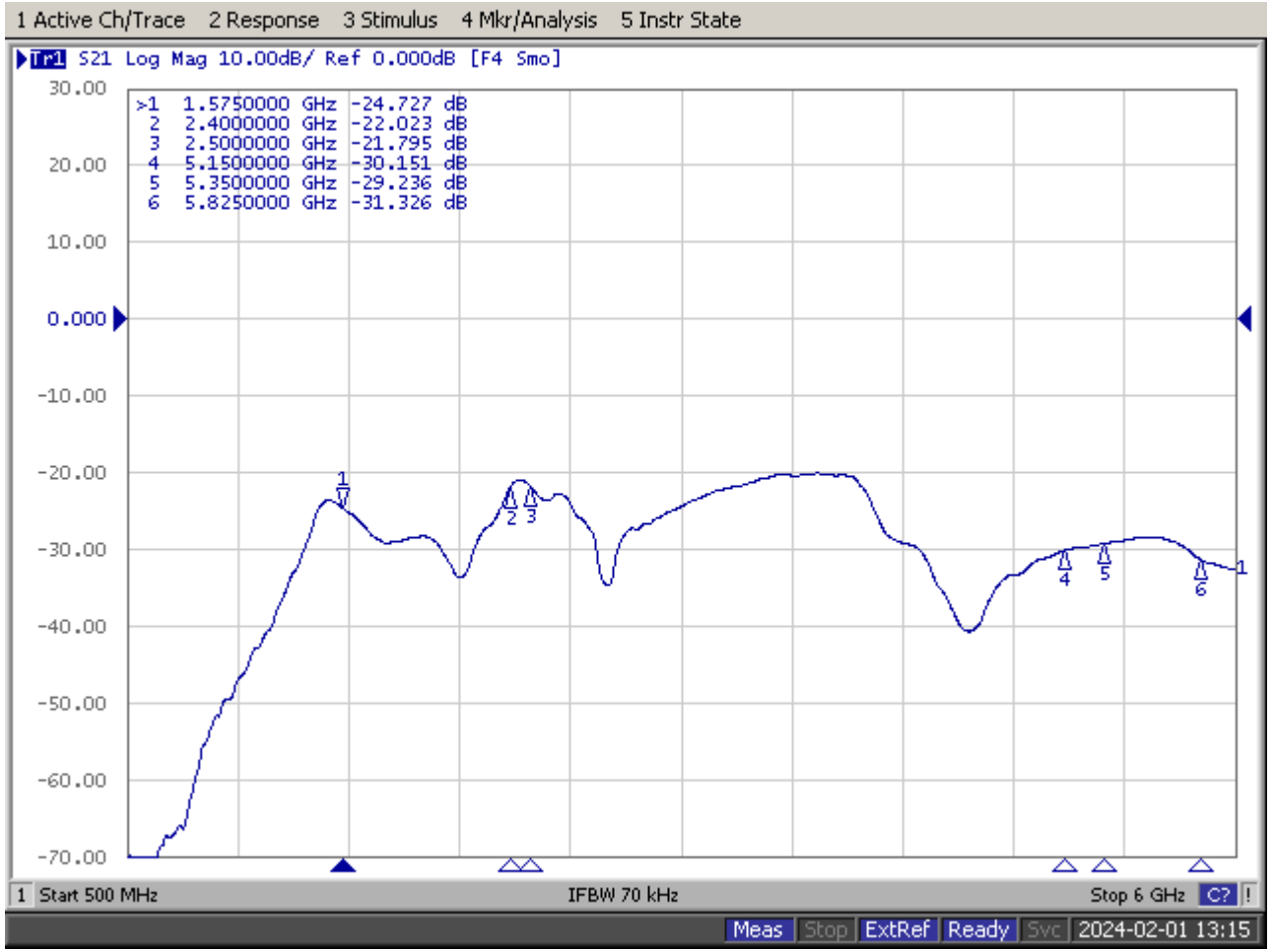


Isolation between 6 GHz and GNSS Antennas



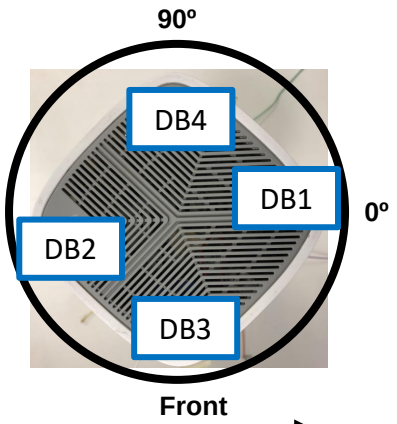
Port 1= 6G5 | Port 2=GNSS

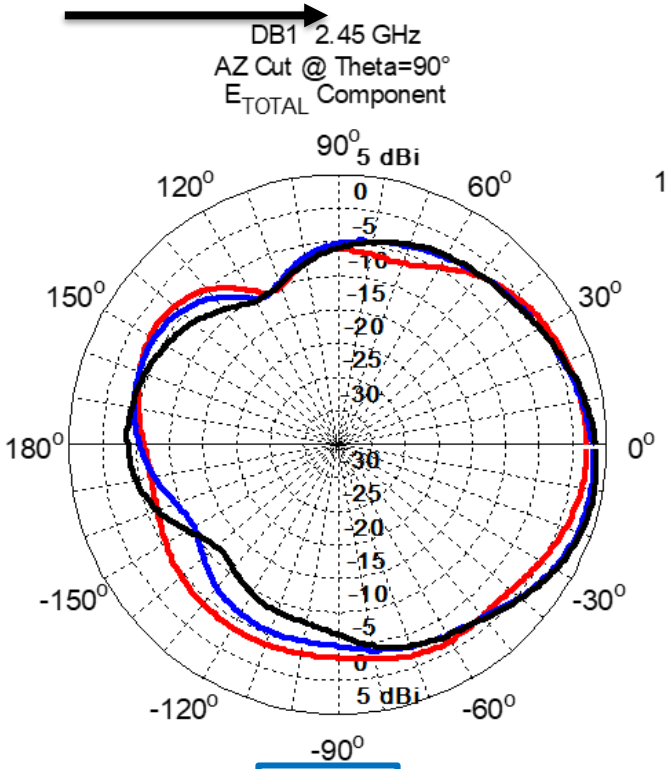
Isolation between SM, DFS and GNSS Antennas

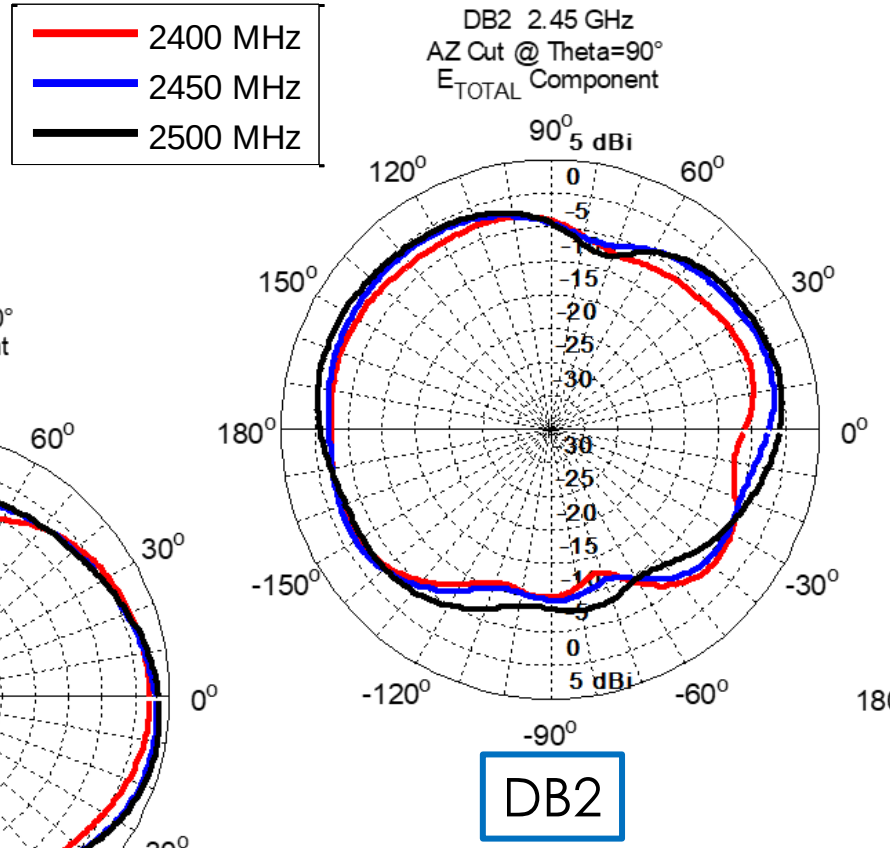


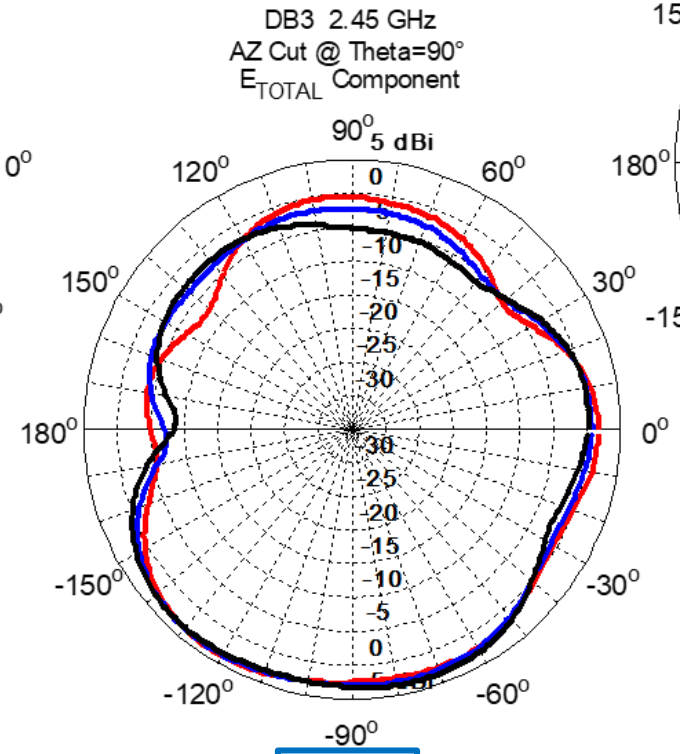
Port 1=GNSS | Port 2= SM-DFS

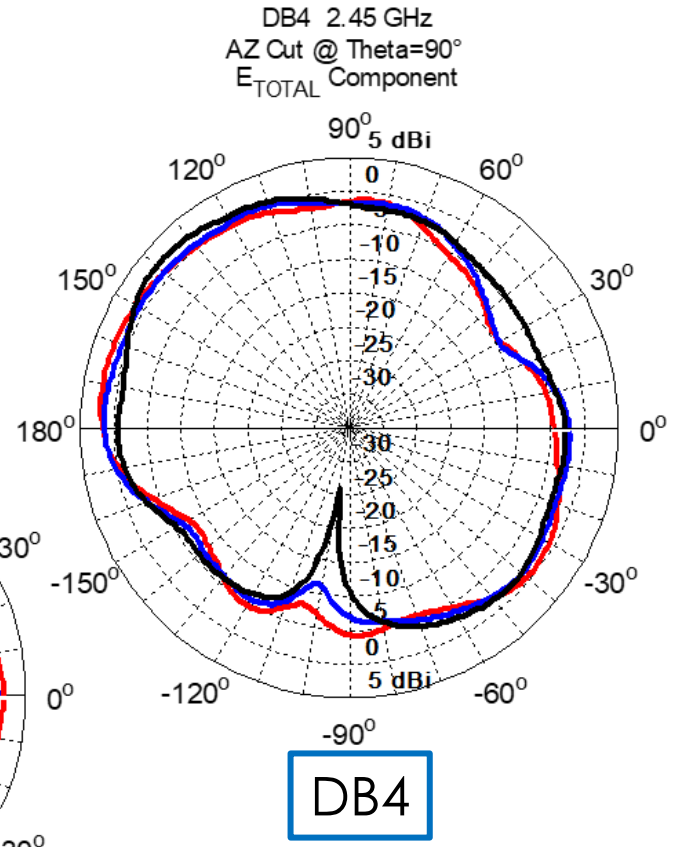
Azimuth Cut - Power Sum
DB 2.45 GHz Antennas



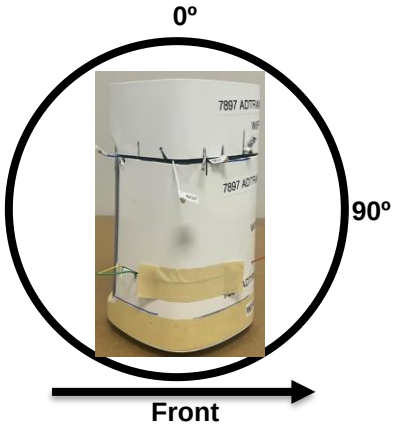


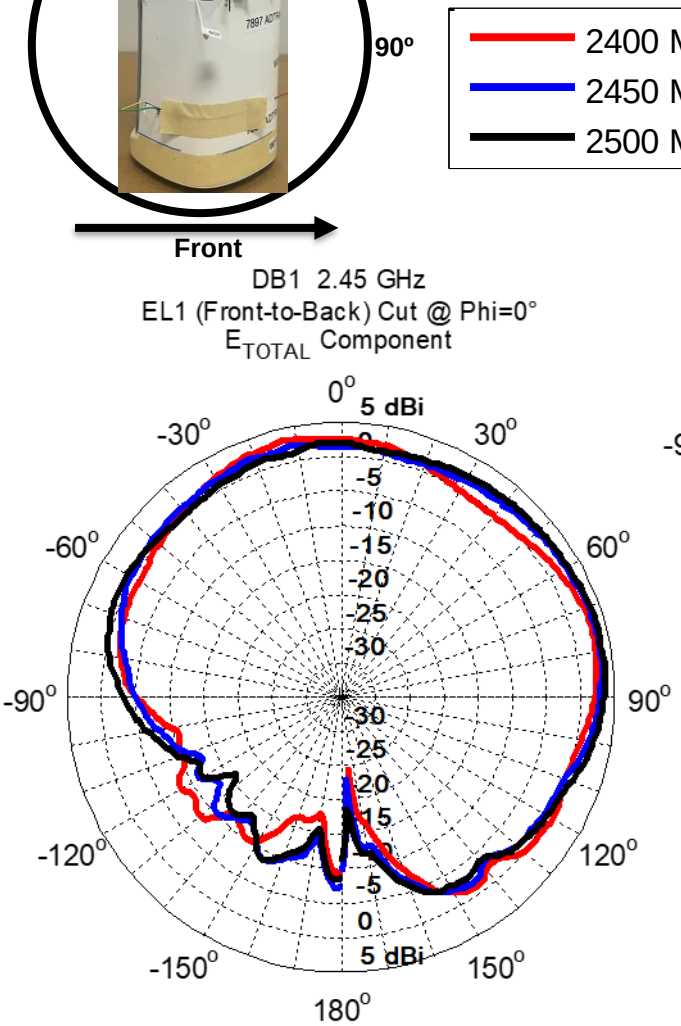




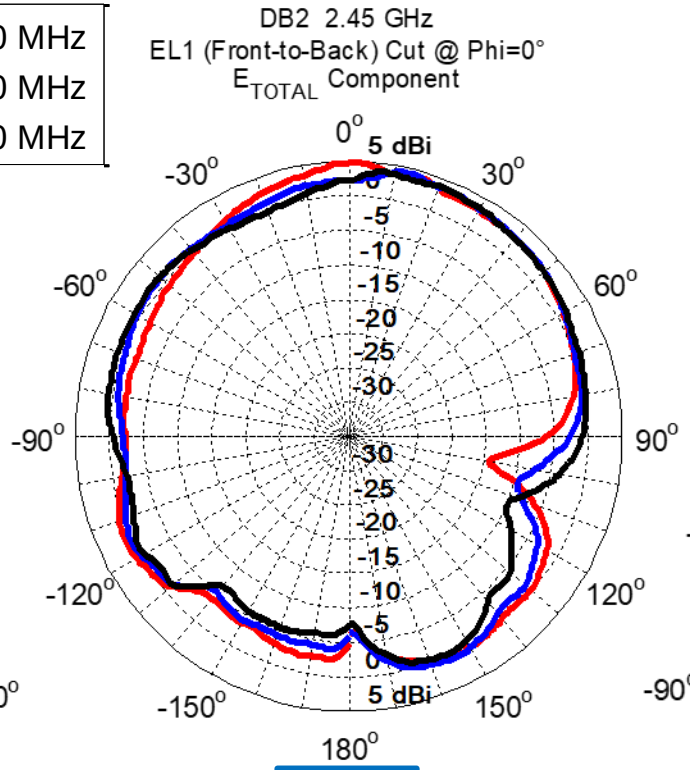


Elevation (Front to Back) Cut - Power Sum
DB 2.45 GHz Antennas

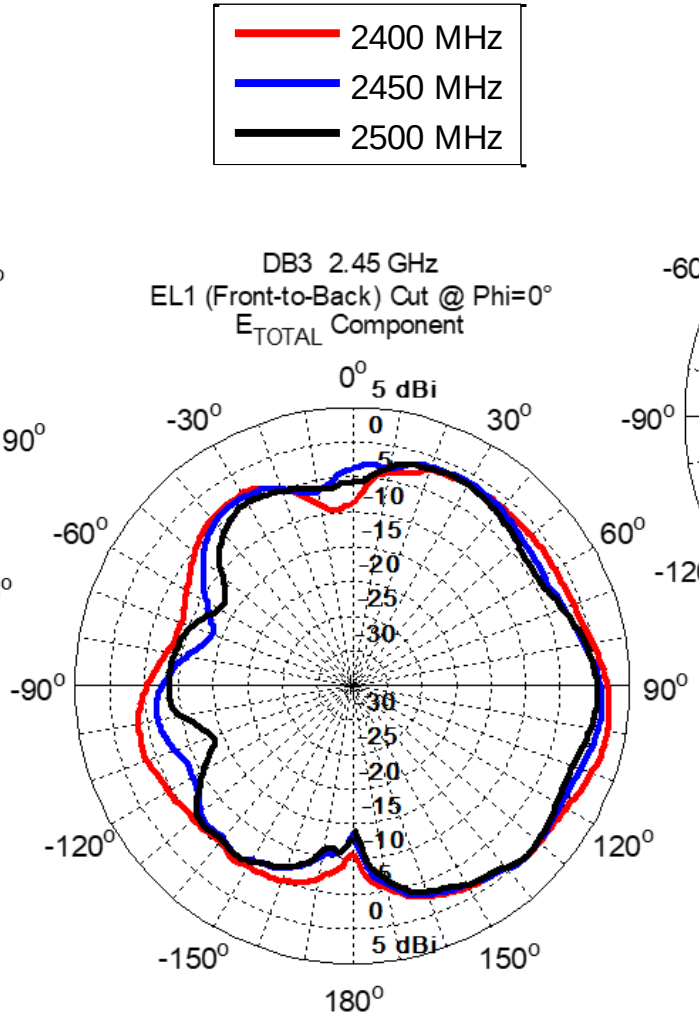




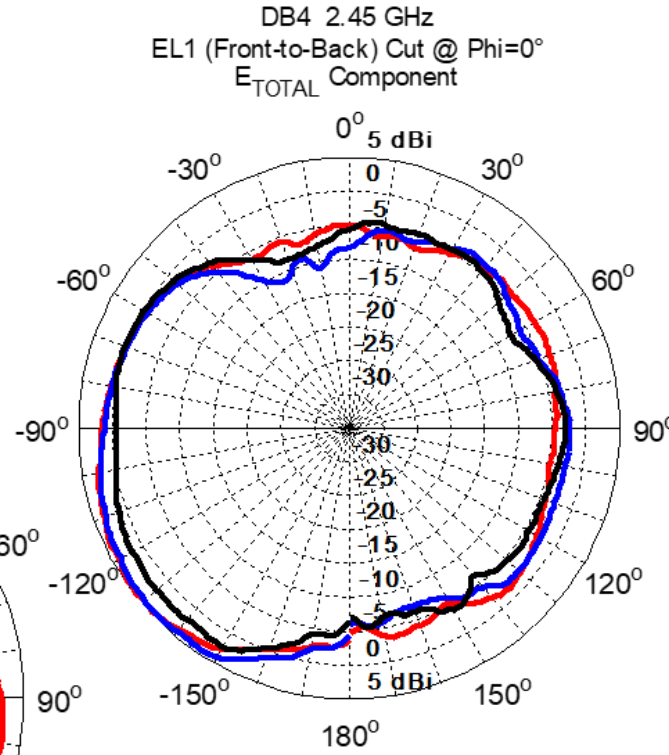
DB1



DB2



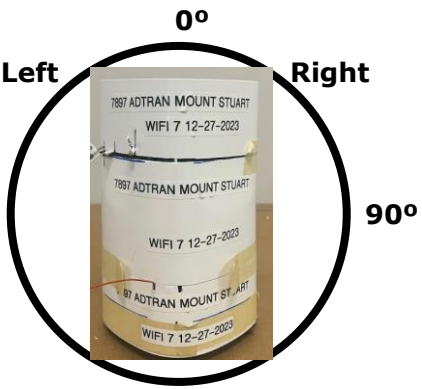
DB3

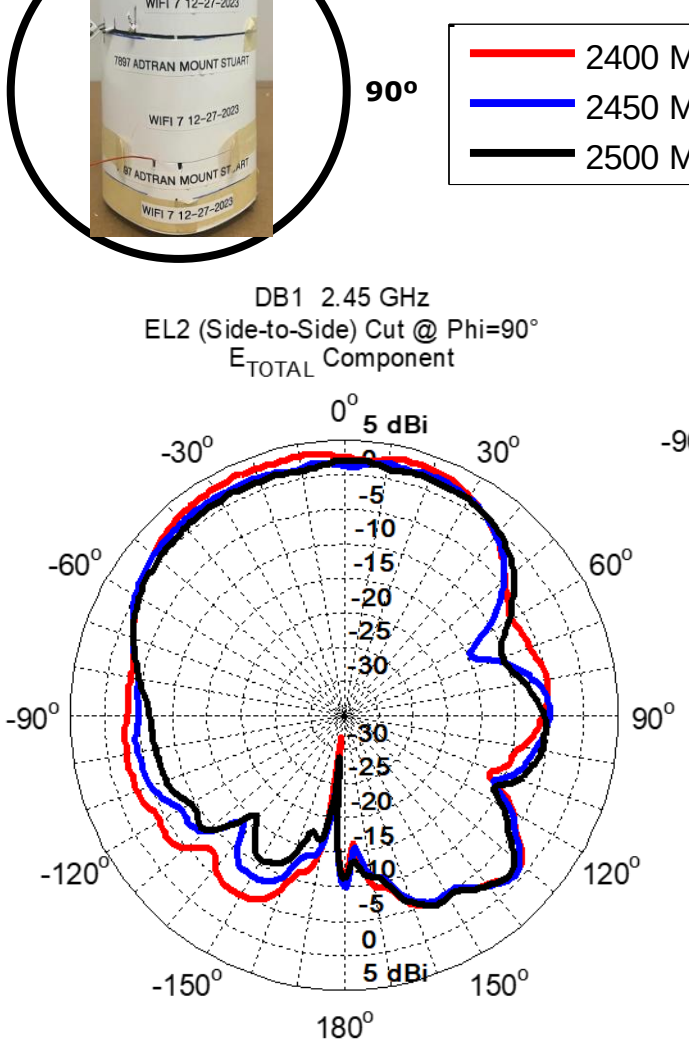


DB4

Elevation (Side to Side) Cut - Power Sum

DB 2.45 GHz Antennas





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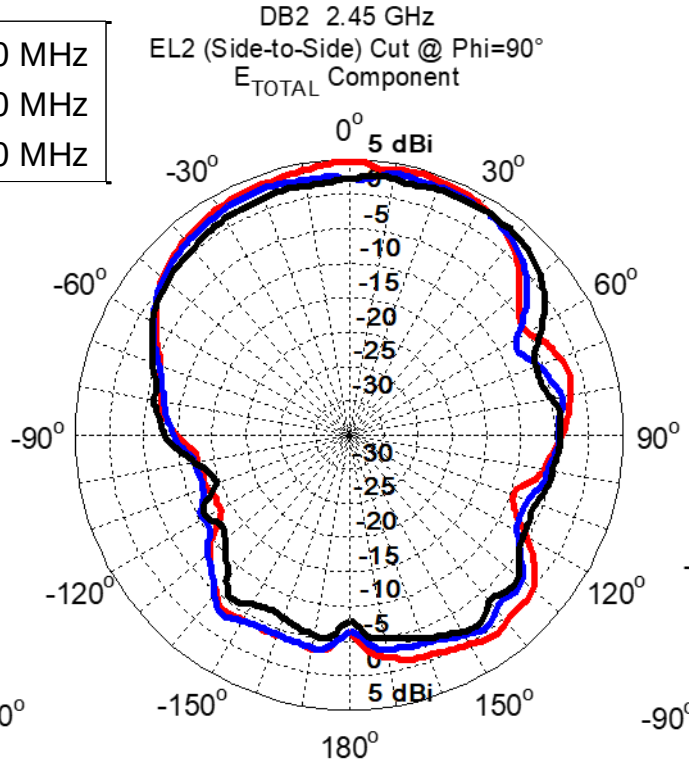

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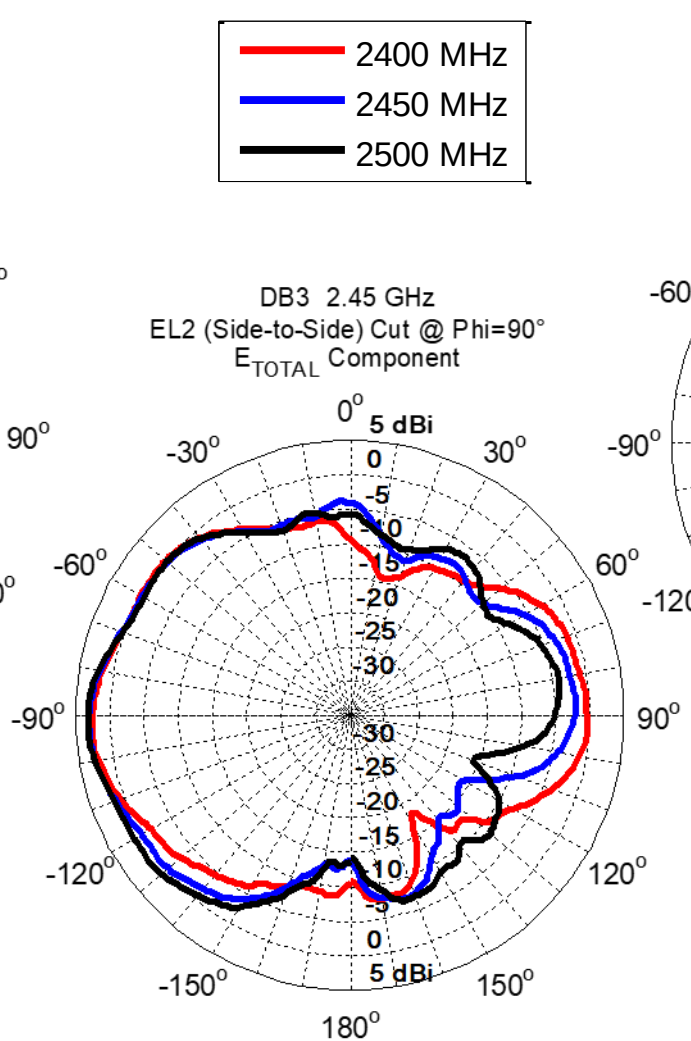

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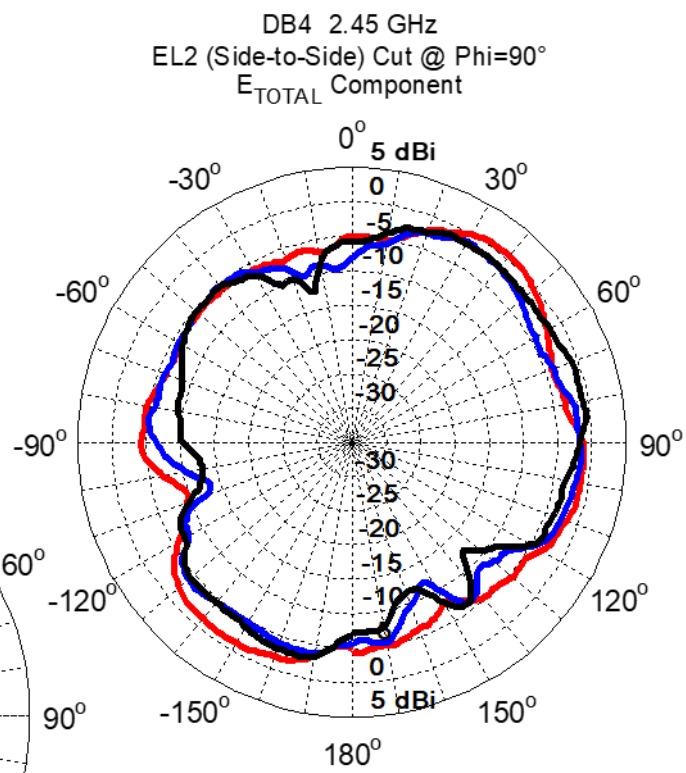
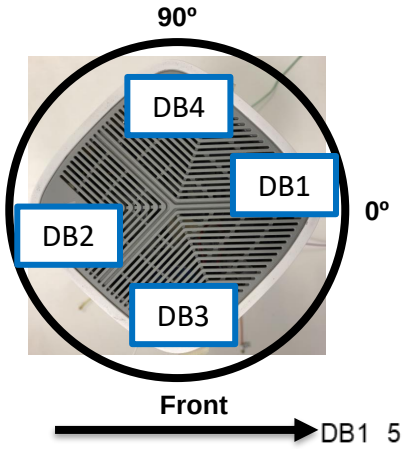
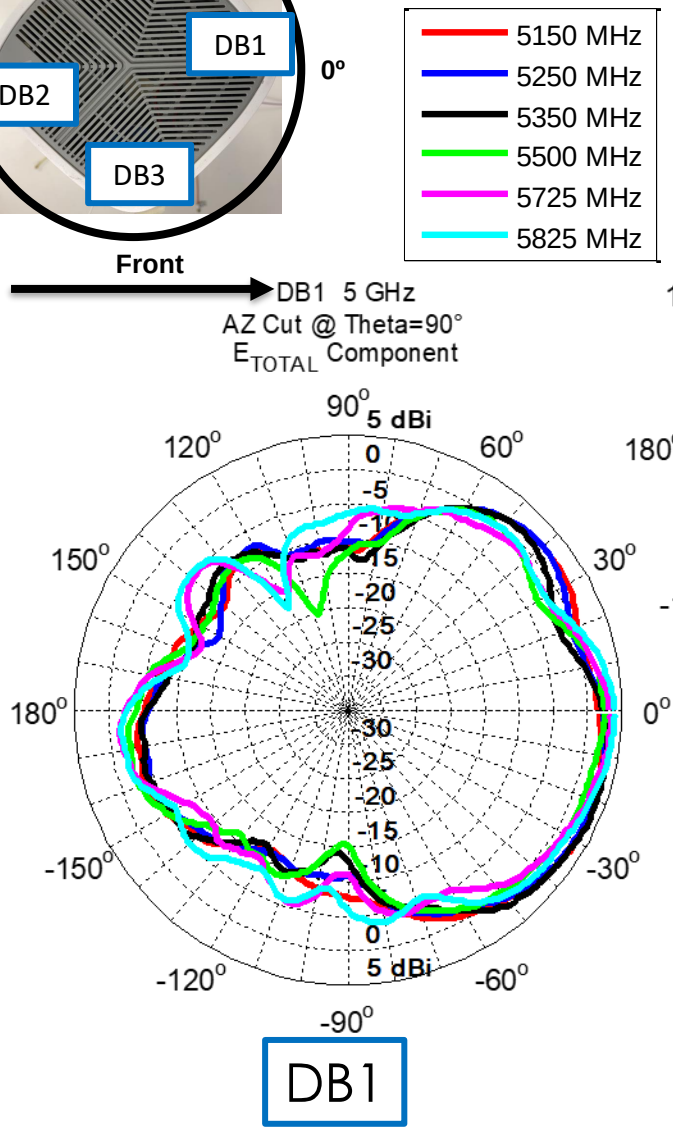
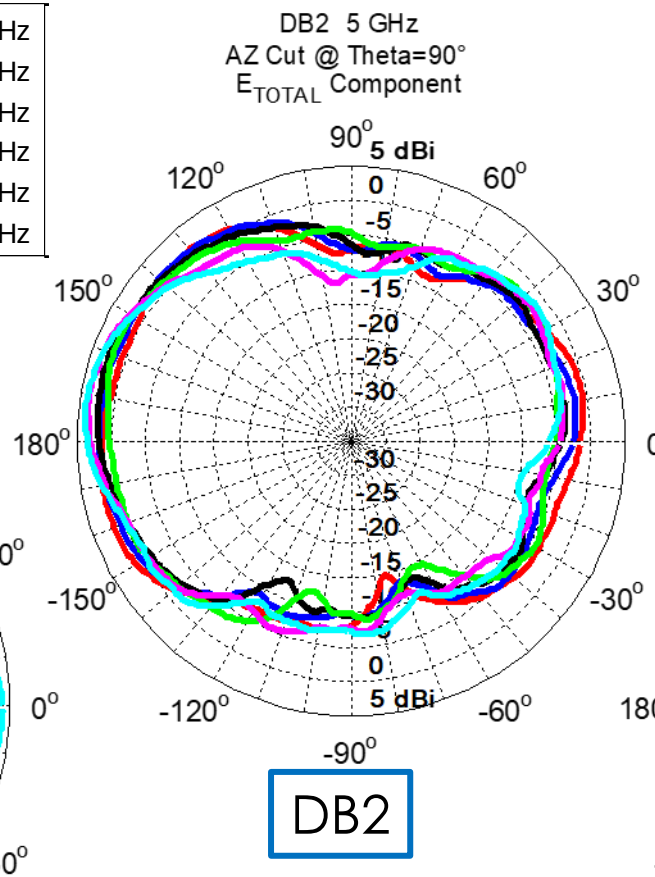


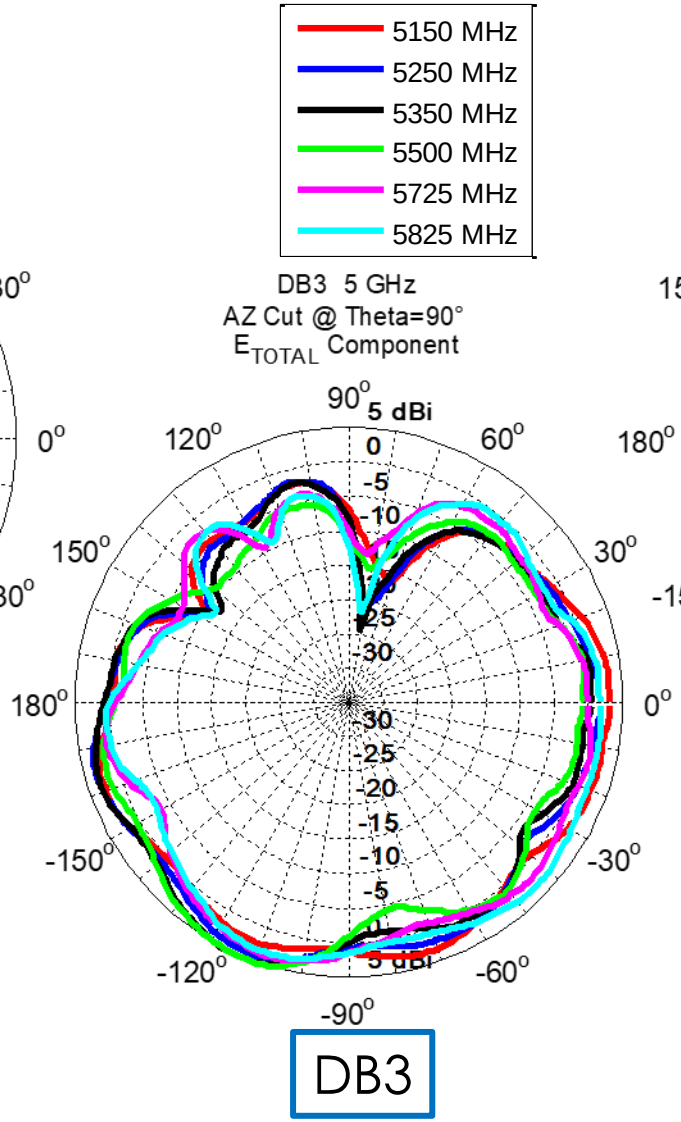
DB4

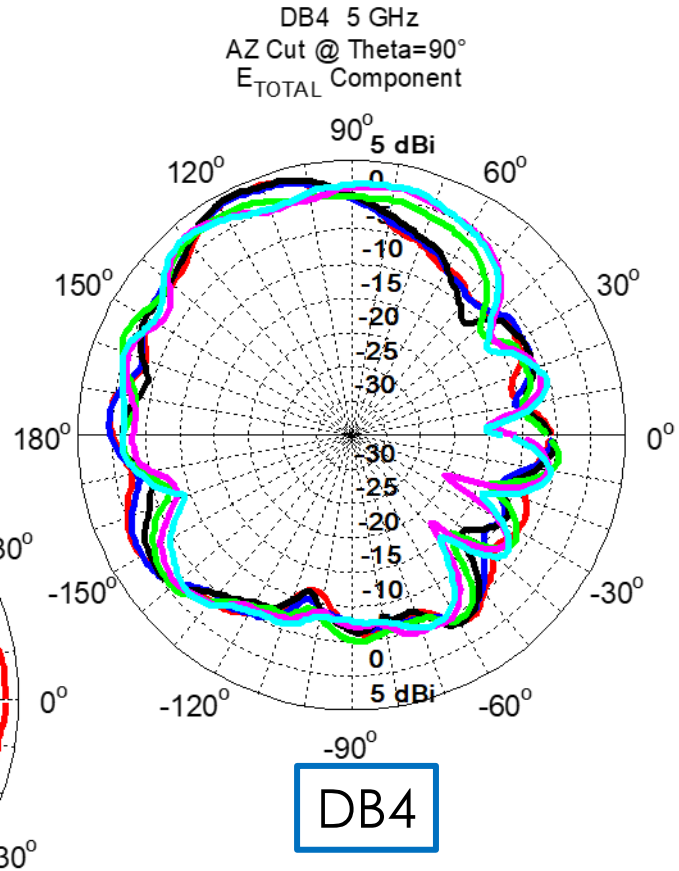
Azimuth Cut - Power Sum
DB 5 GHz Antennas





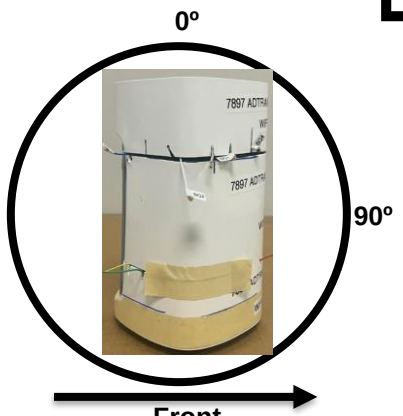


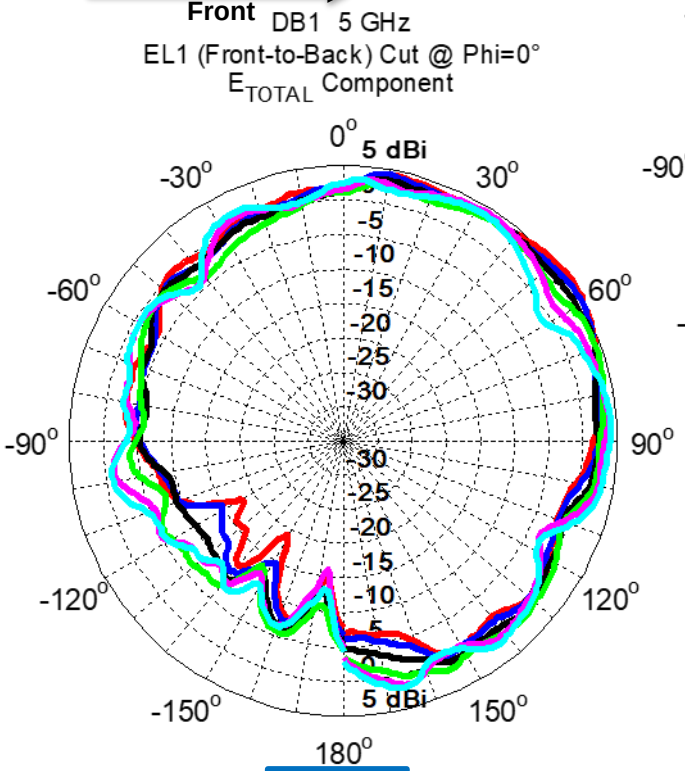




Elevation (Front to Back) Cut - Power Sum

DB 5 GHz Antennas





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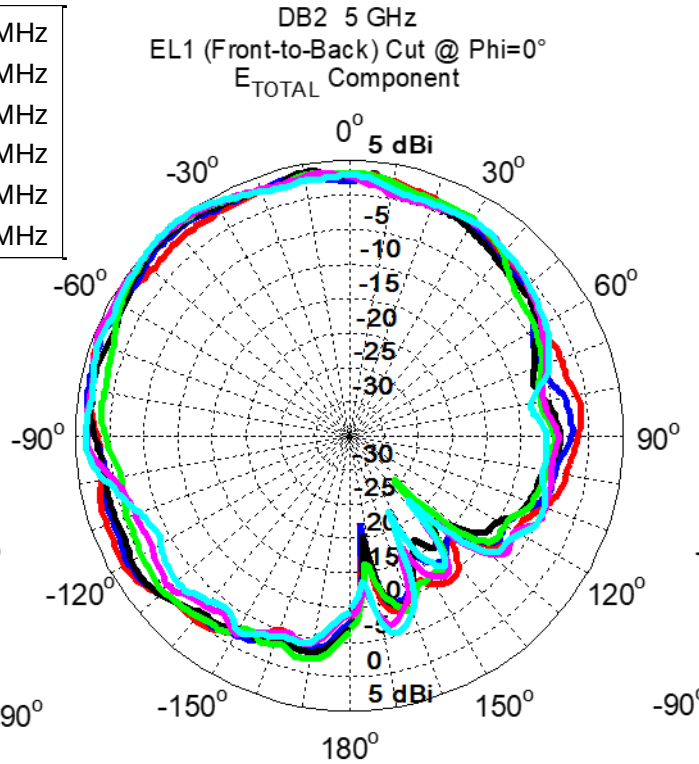

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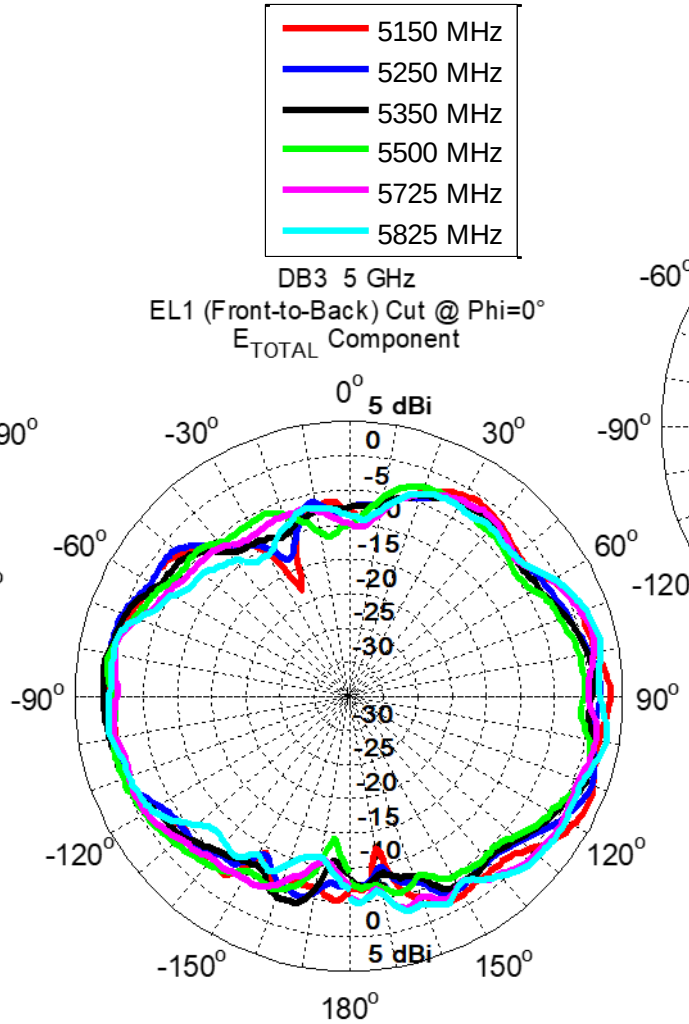

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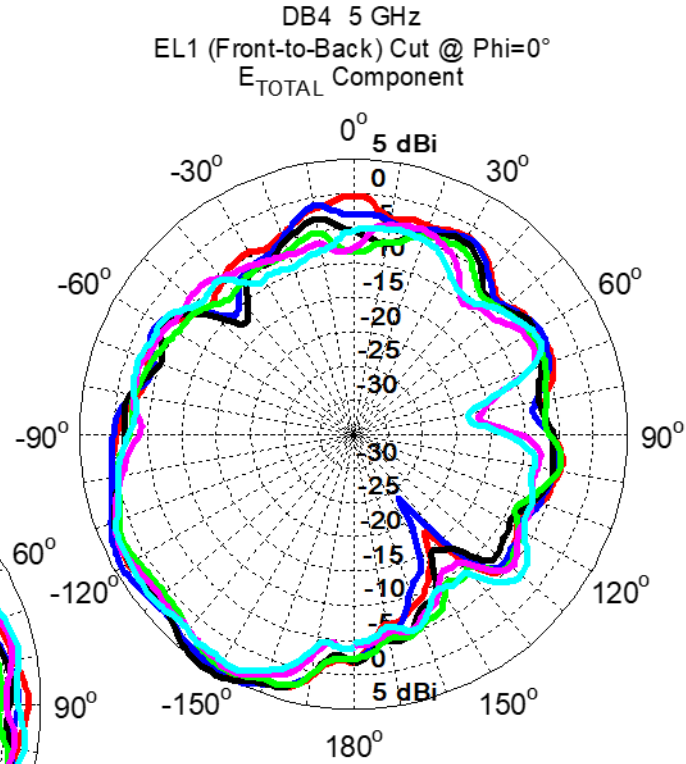
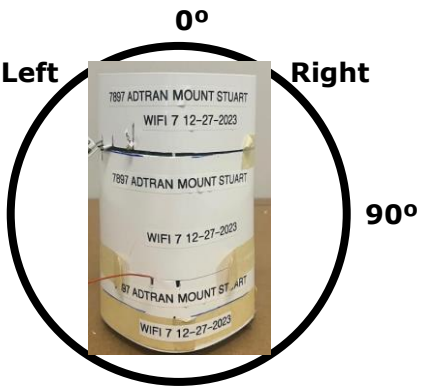
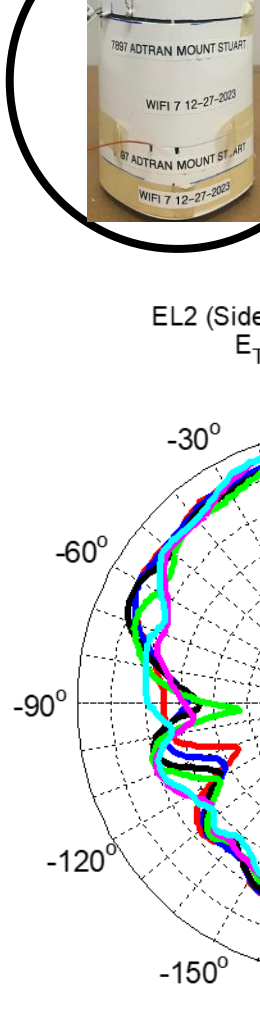


DB4

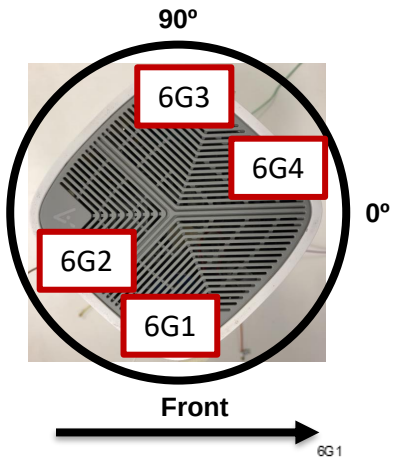
Elevation (Side to Side) Cut - Power Sum

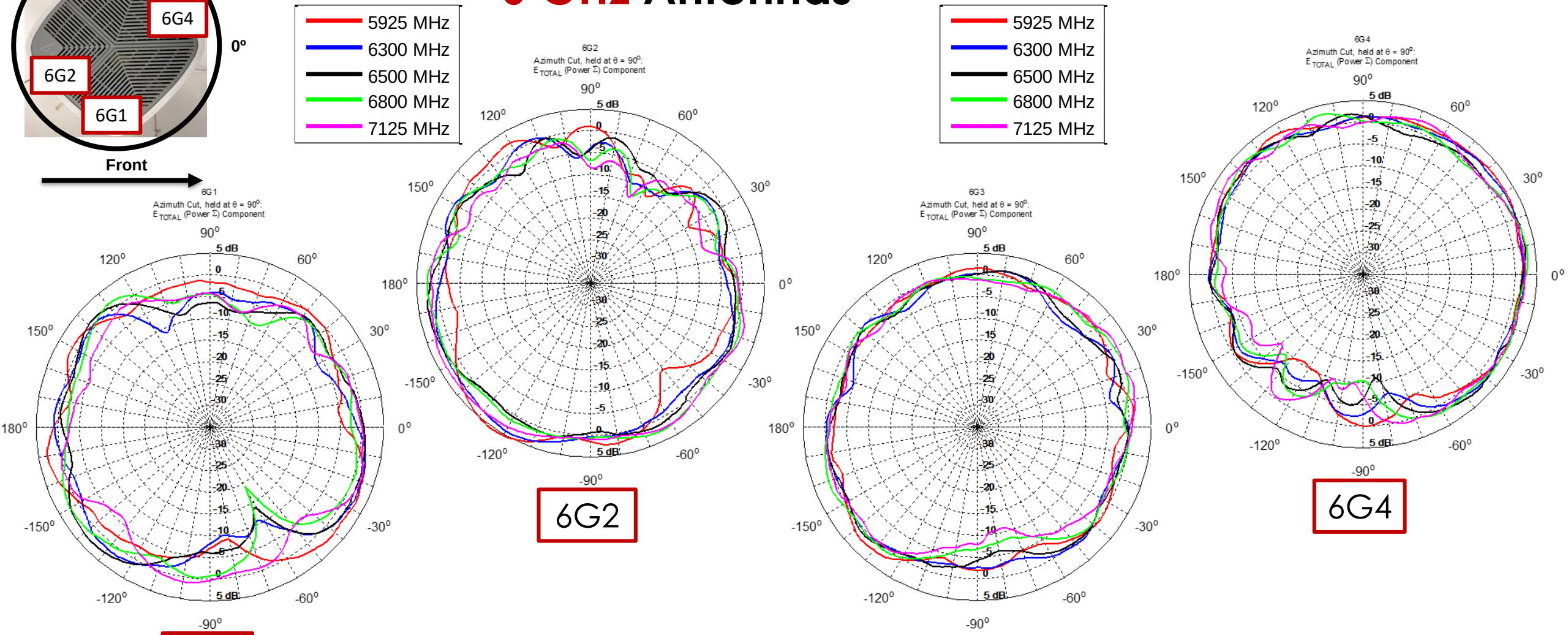
DB 5 GHz Antennas





Azimuth Cut - Power Sum
6 GHz Antennas





6G1

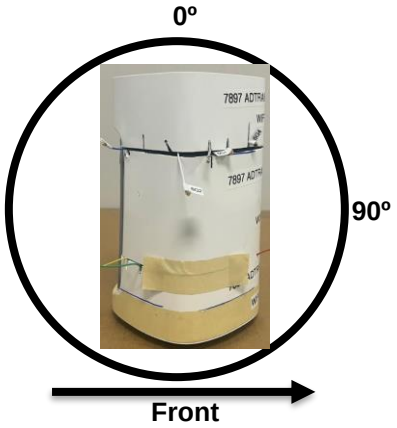
6G2

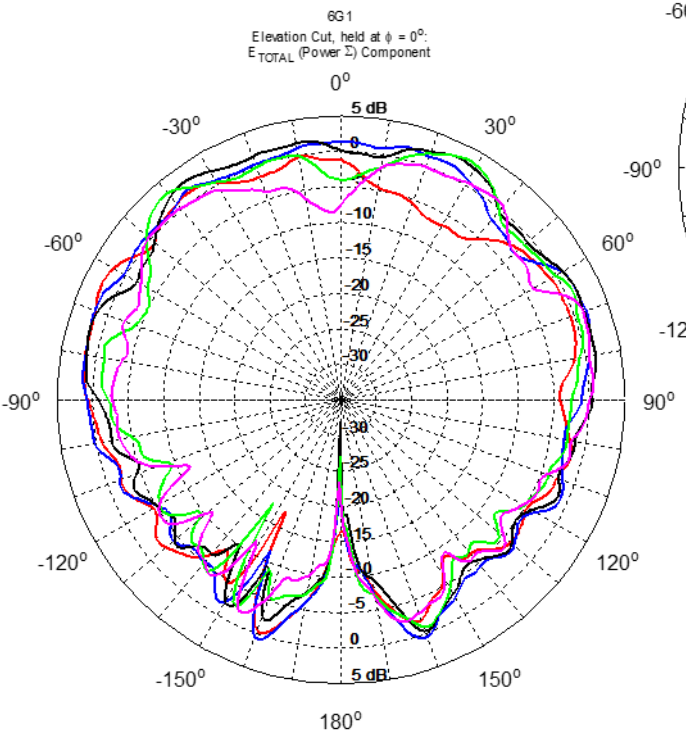
6G3

6G4

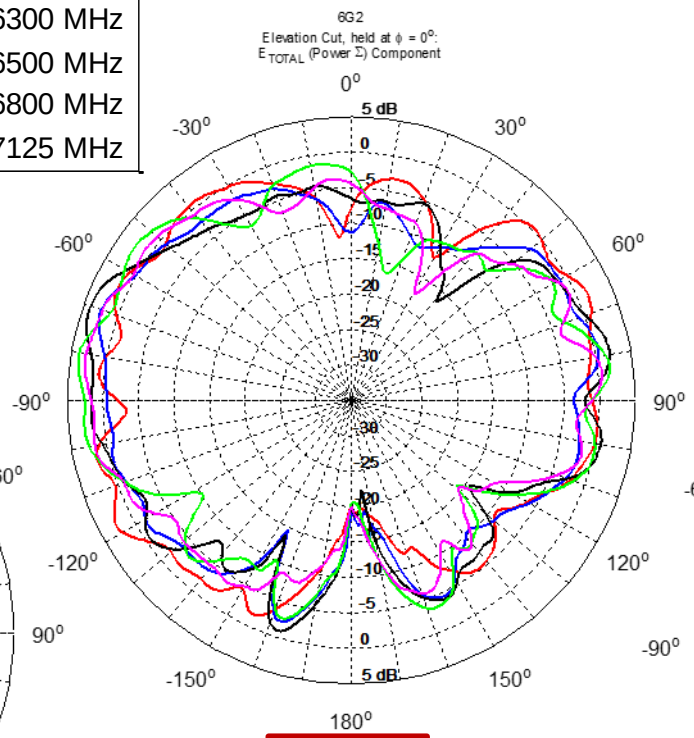
Elevation (Front to Back) Cut - Power Sum

6 GHz Antennas

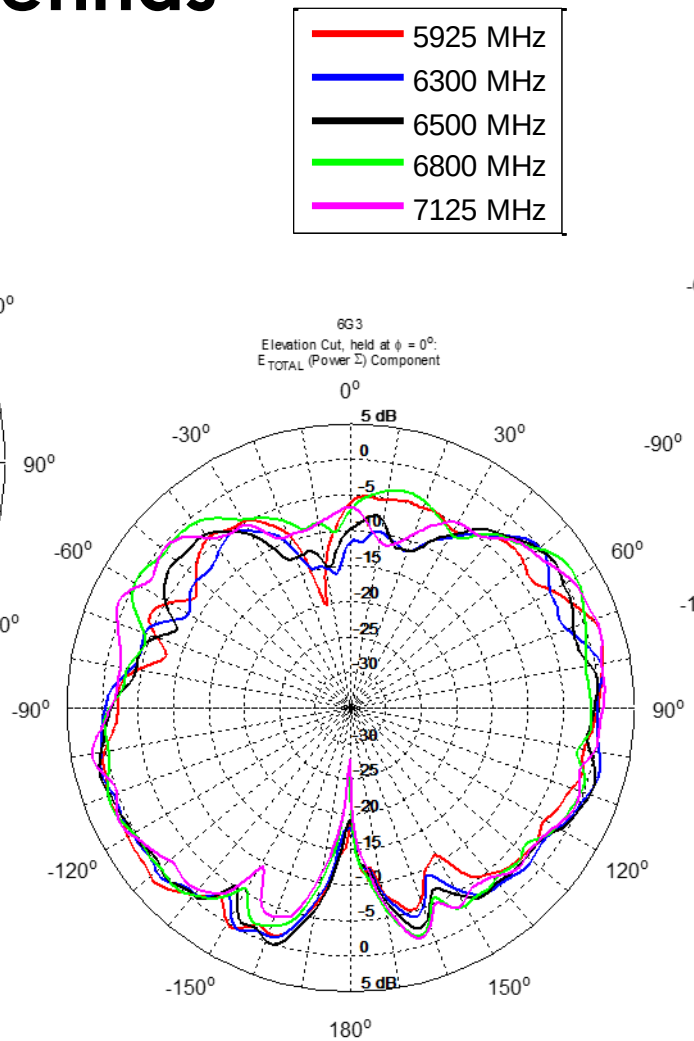




6G1



6G2



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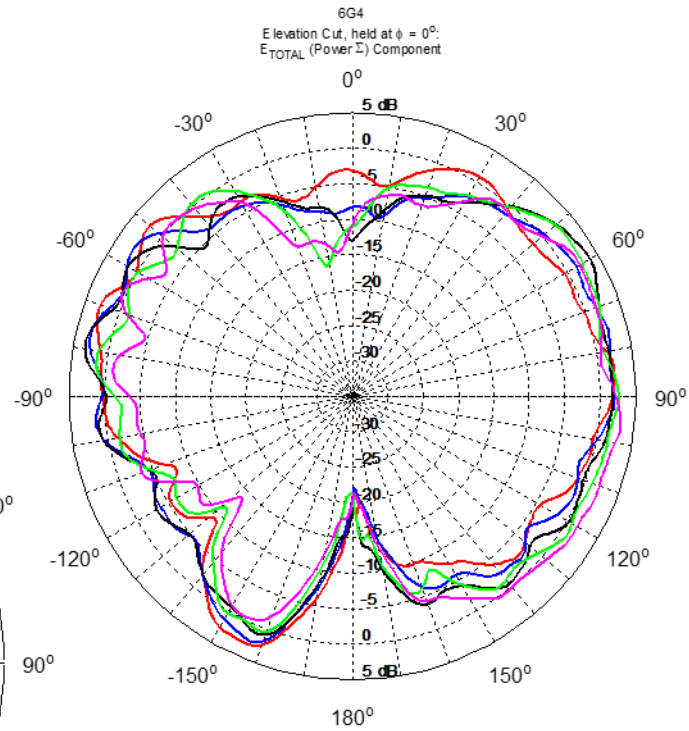
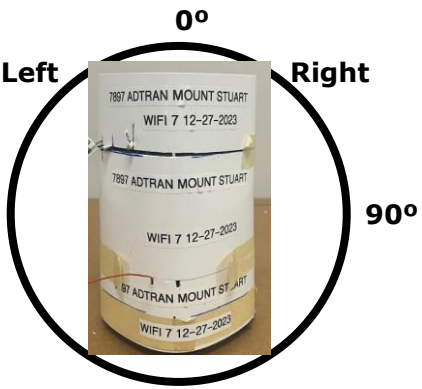
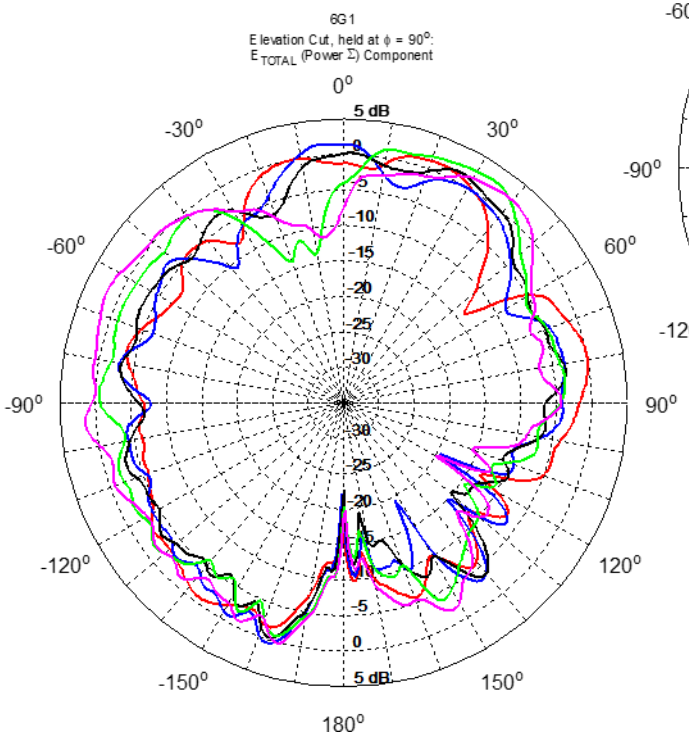


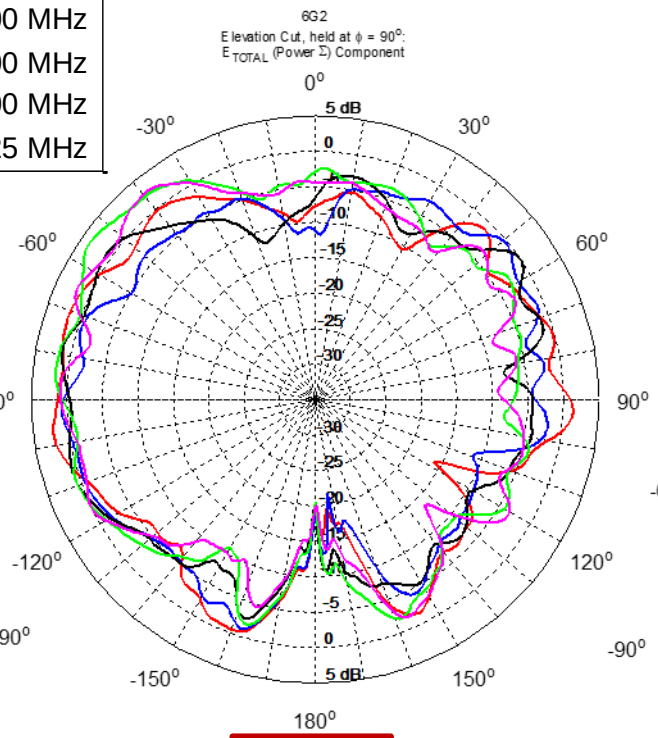
6G4

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





6G1



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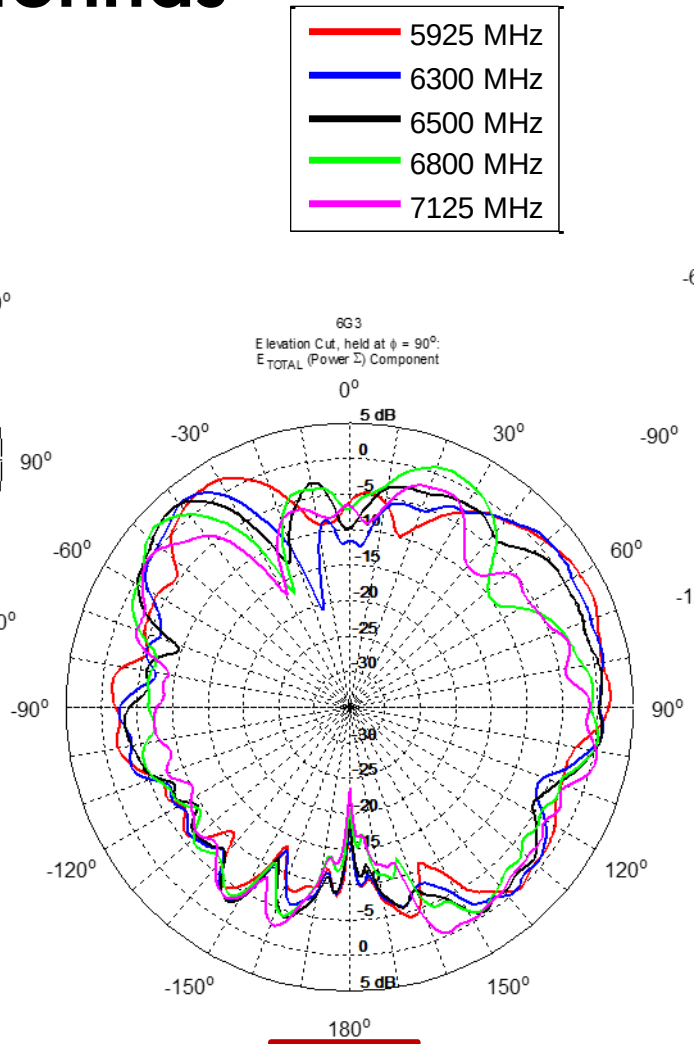
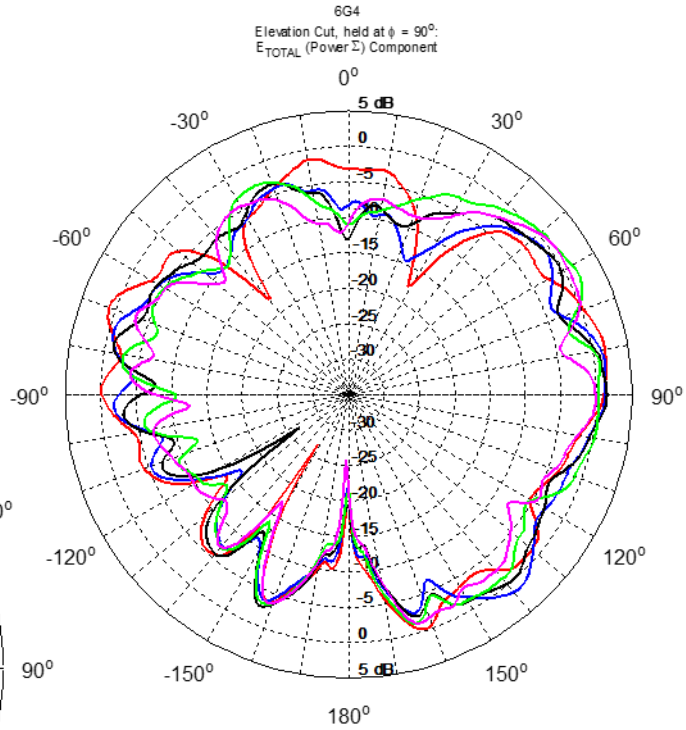


6G3



6G4

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