



TAOGLAS®



Datasheet

9-in-1 Guardian

Part No:
MA990.A.001

Description

Guardian 9-in-1 Combination Adhesive Mount Antenna
1*Active Dual-band GNSS, 8*5G/4G MIMO

Features:

Low-profile IP67 Rated Housing
8*5G/4G MIMO
1*GNSS – GPS/GLONASS/BeiDou/Galileo L1/L2
Cables: GNSS 1m of RG-174, 5G/4G 1m of TGC-1.5DS
Connectors: SMA Male Straight
Dimensions: 148 x 134 x 20.5mm
CE Certified
RoHS & Reach Compliant

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Ireland & USA
ISO 9001:2015
Certified



Taiwan
ISO 9001:2015
Certified



1. Introduction



The Taoglas MA990 Guardian has been designed to be the smallest 9-in-1 combination antenna in the world. The MA990 Guardian is also the worlds first 9-in-1 antenna with dual-band GNSS and high performance 5G/4G allowing it to be compatible with the next generation of modules and routers. The MA990 combines all 9 antenna elements in one low-profile heavy-duty, IP67 rated waterproof, adhesive mount external enclosure.

It comes with 1* Active dual-band GPS/GLONASS/BeiDou/Galileo L1/L2 coverage, 8* 5G/4G Cellular MIMO. The MA990 has been designed as a low profile solution for IoT and Automotive applications where space is at a premium allowing it to be installed in the headliners of vehicles or on the back window of a vehicle.

This is an ideal external combination antenna solution that is used where drilling a hole through the roof of a vehicle or a metal panel for an external antenna is not feasible or desired and can be covertly installed via the adhesive pad supplied with the antenna.

Typical applications include:

- Passenger Bus / Rail / Air Applications.
- Automotive and Heavy Equipment Vehicle Tracking and Telematics
- HD Video over 5G/4G
- First Responder and Emergency Services

The MA990 Guardian has been specifically designed to hit certain 5G bands required for modules, for example MIMO 4 and MIMO are tuned from 600-6000MHz while MIMO 3 and MIMO 6 are tuned from 3000-6000MHz to cover high band 5G and C-band/CBRS applications. This data is shown below in the performance table, and it is recommended to use the suitable connections for your required frequency bands by reviewing this table before connecting the antenna to your device.

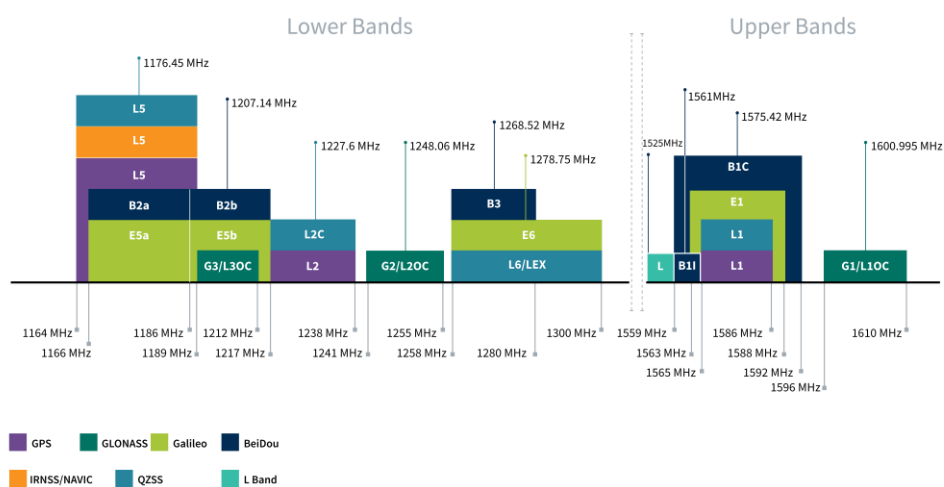
Taoglas also provides services to ensure optimum overall performance for your entire system by working closely with the customer to design in the best antenna and potential additional components for your system.

5G/4G applications demand high-speed data uplink and downlink. High efficiency and high gain MIMO antennas are necessary to achieve the required signal to noise ratio and throughput required to solve these challenges. Taoglas also takes care to ensure high isolation between the MIMO antennas to prevent self interference. Low loss cables are used to keep efficiency high over longer cable lengths. In contrast, smaller MIMO antennas with poorer quality thin cables will have reduced efficiency and isolation, which would lead to a large drop in system throughput, increased incidences of signal drops, and may indeed not make a system connection at all.

Cable type and length, and connector types are fully customizable and the Guardian can also be customized for any variation of antennas below 9-in-1 and the addition of Wi-Fi/Single Band GNSS is also possible. Contact your regional Taoglas customer support team for more information.

2. Specification

GNSS Frequency Bands					
GPS	L1 1575.42 MHz	L2 1227.6 MHz	L5 1176.45 MHz		
	■	■	□		
GLONASS	G1 1602 MHz	G2 1248 MHz	G3 1207 MHz		
	■	□	■		
Galileo	E1 1575.24 MHz	E5a 1176.45 MHz	E5b 1201.5 MHz	E6 1278.75 MHz	
	■	□	□	□	
BeiDou	B1C 1575.42 MHz	B1I 1561 MHz	B2a 1176.45 MHz	B2b 1207.14 MHz	B3 1268.52 MHz
	■	□	□	□	□
L-Band	L-Band 1542 MHz				
	□				
QZSS (Regional)	L1 1575.42 MHz	L2C 1227.6 MHz	L5 1176.45 MHz	L6 1278.75e6	
	■	□	□	□	
IRNSS (Regional)	L5 1176.45 MHz				
	□				
SBAS	L1/E1/B1 1575.42 MHz	L5/B2a/E5a 1176.45 MHz	G1 1602 MHz	G2 1248 MHz	G3 1207 MHz
	■	□	□	□	□



GNSS Bands and Constellations

GNSS Electrical						
Frequency (MHz)	GPS_L2	GLONASS_G2	BeiDou_B1	Galileo_E1	GPS_L1	GLONASS
	1207-1239	1241-1248	1559-1563	1563-1587	1564-1587	1593-1610
Efficiency (%)	63.2	47.5	36.3	69.1	69.1	36.1
Average Gain (dB)	-1.99	-3.23	-4.40	-1.60	-1.60	-4.42
Peak Gain (dBi)	4.24	3.19	0.92	3.69	3.69	0.82
Axial Ratio	13.7	22.2	17.4	8.6	6.6	19.1
Impedance	50 Ω					
Polarization	RHCP					

LNA and Filter Electrical Properties						
Frequency (MHz)	GPS_L2	GLONASS_G2	BeiDou_B1	Galileo_E1	GPS_L1	GLONASS
	1207-1239	1241-1248	1559-1563	1563-1587	1564-1587	1593-1610
Gain (dB)	19.8	19.6	22.7	22.6	22.6	21.4
Noise Figure (dB)	3.8	4.4	2.4	2.3	2.3	2.4
Return Loss (dB)	< -10					
Input Voltage (V)	+ 1.8 to 5.5					
Current consumption (mA)	16.8 \pm 3					
Outer Band Attenuation (dB) (reference level from 0dB)	30 @ Fc +/-100MHz 40 @ Fc +/-200MHz					

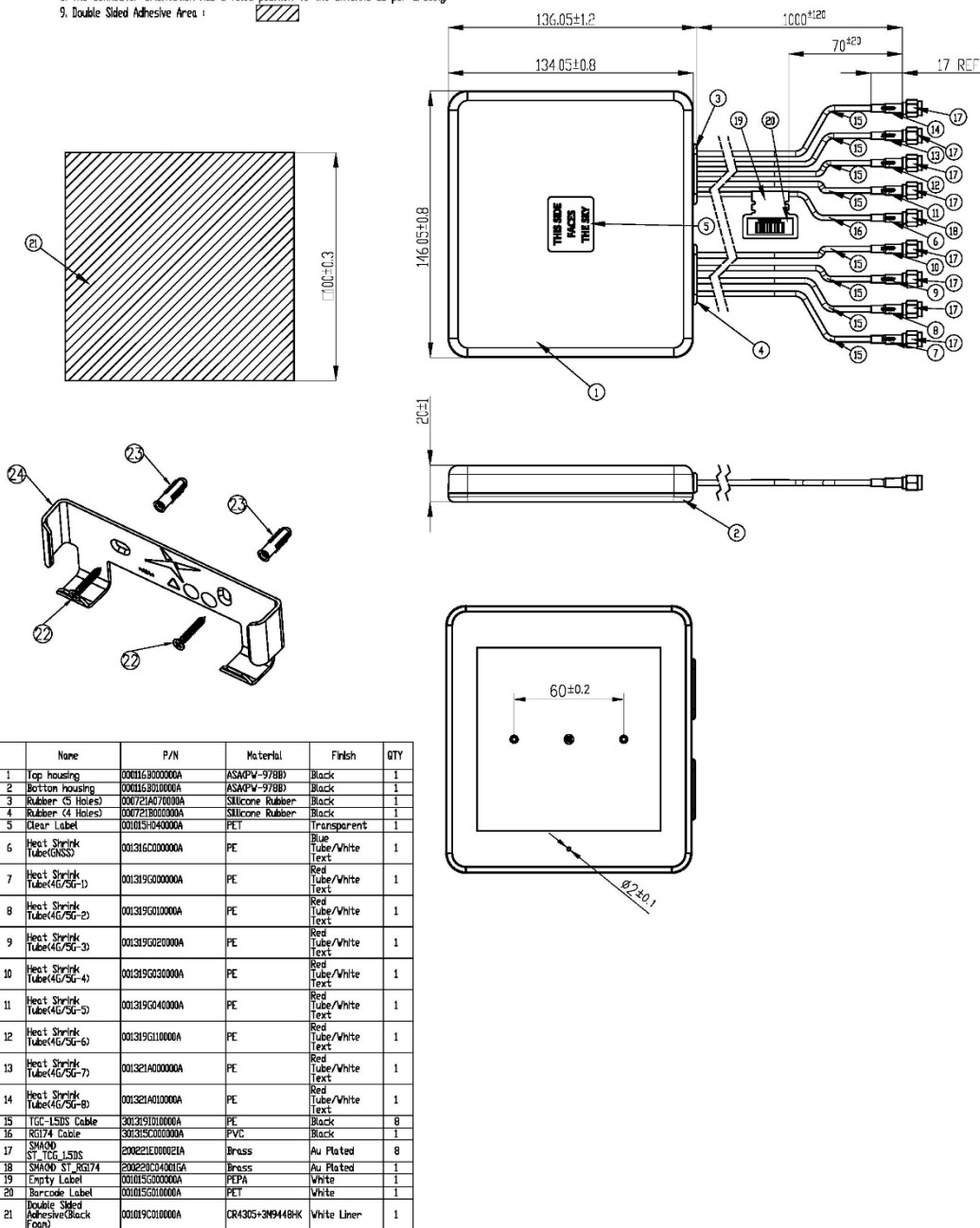
5G/4G Electrical								
Band	Frequency (MHz)		Efficiency (%)	Average Gain (dB)	Peak Gain (dBi)	Impedance	Polarization	Max. input power
5GNR B71	617-698	MIMO 1	-	-	-	50 Ω	Linear	3W
		MIMO 2	-	-	-			
		MIMO 3	-	-	-			
		MIMO 4	39.9	-3.99	0.48			
		MIMO 5	36.8	-4.34	0.07			
		MIMO 6	-	-	-			
		MIMO 7	-	-	-			
		MIMO 8	-	-	-			
LTE 700	698-806	MIMO 1	-	-	-	50 Ω	Linear	3W
		MIMO 2	-	-	-			
		MIMO 3	-	-	-			
		MIMO 4	41.8	-3.78	1.09			
		MIMO 5	43.7	-3.59	2.24			
		MIMO 6	-	-	-			
		MIMO 7	-	-	-			
		MIMO 8	-	-	-			
LTE 800/900	824-960	MIMO 1	-	-	-	50 Ω	Linear	3W
		MIMO 2	-	-	-			
		MIMO 3	-	-	-			
		MIMO 4	49.1	-3.08	2.94			
		MIMO 5	51.1	-2.92	3.86			
		MIMO 6	-	-	-			
		MIMO 7	-	-	-			
		MIMO 8	-	-	-			
5GNR 1500	1427-1518	MIMO 1	-	-	-	50 Ω	Linear	3W
		MIMO 2	36.2	-4.41	2.20			
		MIMO 3	-	-	-			
		MIMO 4	37.4	-4.27	-0.12			
		MIMO 5	41.8	-3.78	0.14			
		MIMO 6	-	-	-			
		MIMO 7	39.0	-4.08	1.62			
		MIMO 8	-	-	-			
5GNR n66	1710-2170	MIMO 1	53.2	-2.74	4.00	50 Ω	Linear	3W
		MIMO 2	53.0	-2.75	2.21			
		MIMO 3	-	-	-			
		MIMO 4	45.7	-3.40	3.53			
		MIMO 5	51.4	-2.89	3.25			
		MIMO 6	-	-	-			
		MIMO 7	52.6	-2.79	2.44			
		MIMO 8	52.7	-2.78	3.58			
LTE 2600	2300-2690	MIMO 1	49.0	-3.10	3.28	50 Ω	Linear	3W
		MIMO 2	47.9	-3.20	1.87			
		MIMO 3	-	-	-			
		MIMO 4	47.0	-3.28	3.31			
		MIMO 5	44.5	-3.51	2.60			
		MIMO 6	-	-	-			
		MIMO 7	45.0	-3.47	2.75			
		MIMO 8	47.1	-3.27	4.50			
5GNR n78	3300-3800	MIMO 1	51.5	-2.88	5.39	50 Ω	Linear	3W
		MIMO 2	-	-	-			
		MIMO 3	41.0	-3.87	3.95			
		MIMO 4	45.2	-3.45	2.87			
		MIMO 5	47.7	-3.21	2.46			
		MIMO 6	37.9	-4.21	4.21			
		MIMO 7	-	-	-			
		MIMO 8	52.0	-2.84	5.08			
LTE 5200	5150-5925	MIMO 1	50.9	-2.93	5.18	50 Ω	Linear	3W
		MIMO 2	-	-	-			
		MIMO 3	53.7	-2.70	5.34			
		MIMO 4	45.1	-3.46	7.07			
		MIMO 5	41.9	-3.78	6.62			
		MIMO 6	46.3	-3.34	4.24			
		MIMO 7	-	-	-			
		MIMO 8	51.5	-2.88	4.83			

Mechanical	
Dimensions	146 x 134 x 20.5mm
Weight	800g
Cable	1m TGC-1.5DS for 5G/4G – Fully Customizable 1m RG174 for GNSS – Fully Customizable
Connector	5G/4G: SMA Male Straight – Fully Customizable GNSS: SMA Male Straight – Fully Customizable
Housing Material	ASA
Adhesive	CR4305 + 3M 9448HK

Environmental	
IP Rating	IP67
Operation Temperature	-40°C ~ +85°C
Storage Temperature	-40°C ~ +85°C
Humidity	Non-condensing 65°C 95% RH

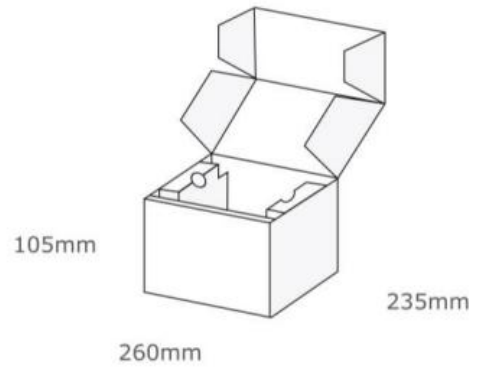
3. Mechanical Drawing

- NOTES:
1. All material must be RoHS compliant.
 2. Color Codes: PANTONE Black / Plastics Color 0728-1-1.
 3. Finish: Mirror Polish / SPI A-2.
 4. Deburring: Less than 0.02mm.
 5. No gate, parting line and any other tooling marks on appearance of product.
 6. Once product have any crack/break/thread damage or any structural tooling issue, molding supplier need to correct the issue unconditionally.
 7. Use this drawing together with the corresponding 3D CAD database file to fully describe the part.
 8. The connector orientation has a fixed position to the antenna as per drawing.
 9. Double Sided Adhesive Area:

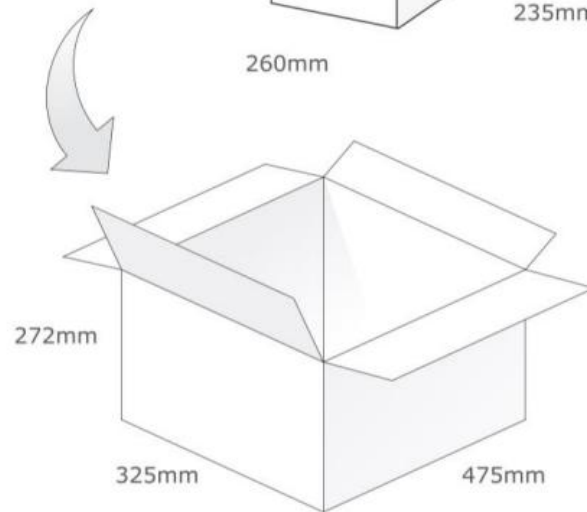


4. Packaging

1 No. MA990.A.001 per small box
 Box Dimensions - 260*235*105mm
 Weight - 1.16Kg



1 Outer Carton
 Carton Dimensions - 540*490*240mm
 8 pcs MA990.A.001 per carton
 Weight - 9.9Kg



5. Antenna Characteristics

5.1 Test Set-up

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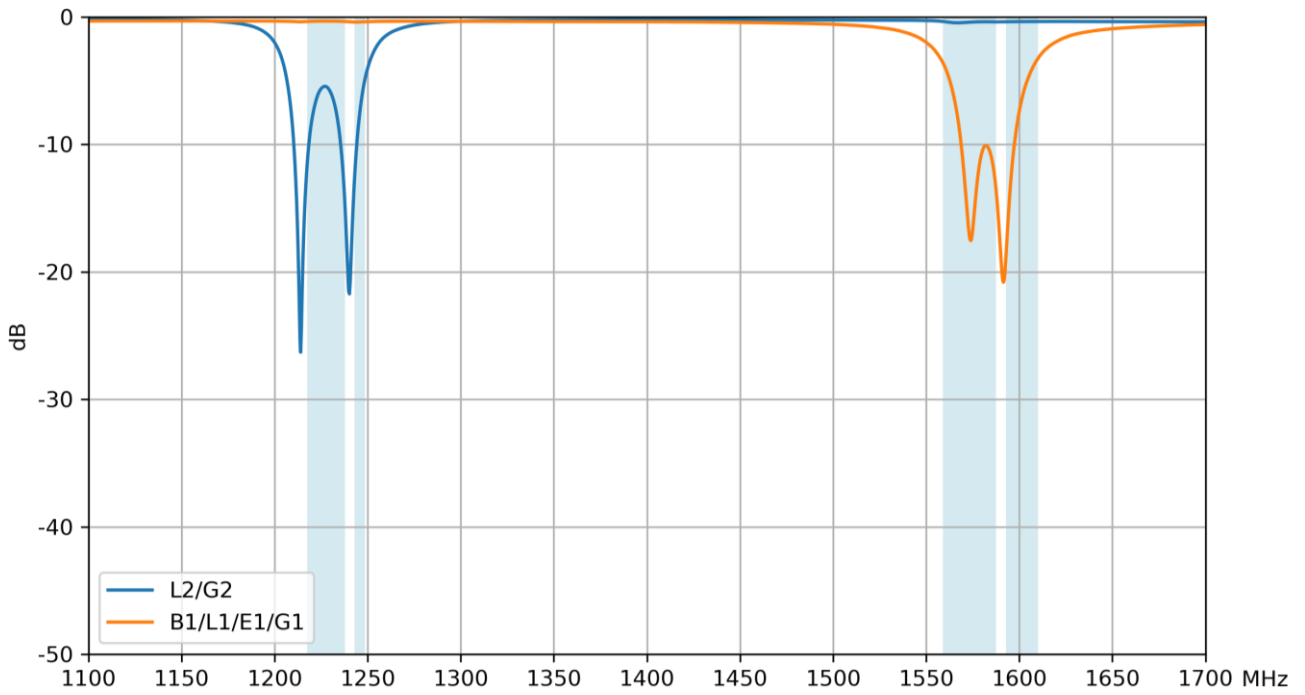


Vector Network Analyzer

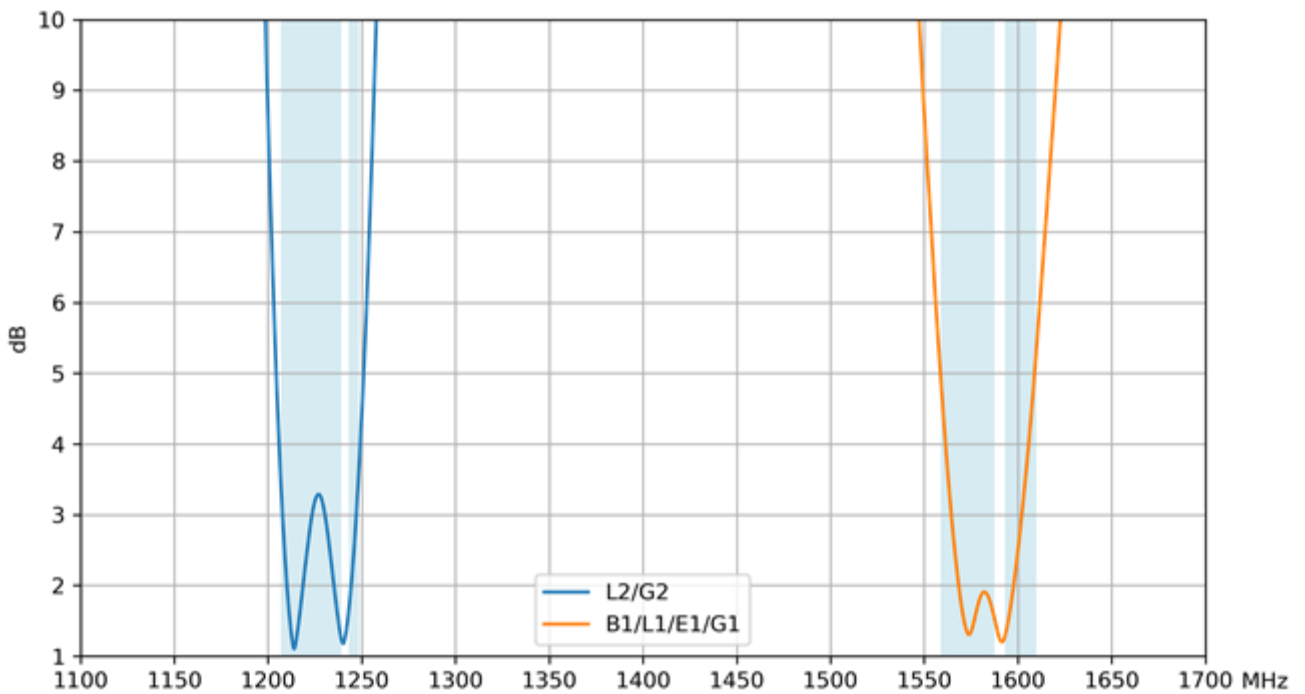


VNA Test Set-up

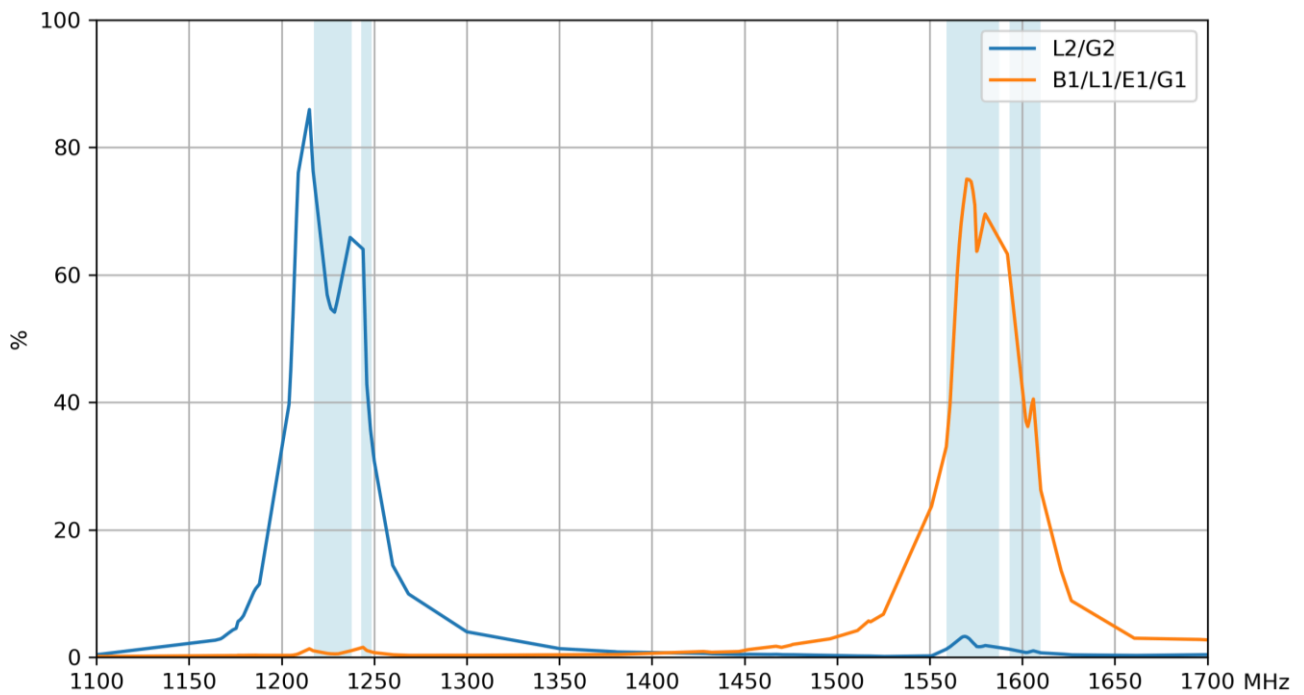
5.2 Return Loss - GNSS



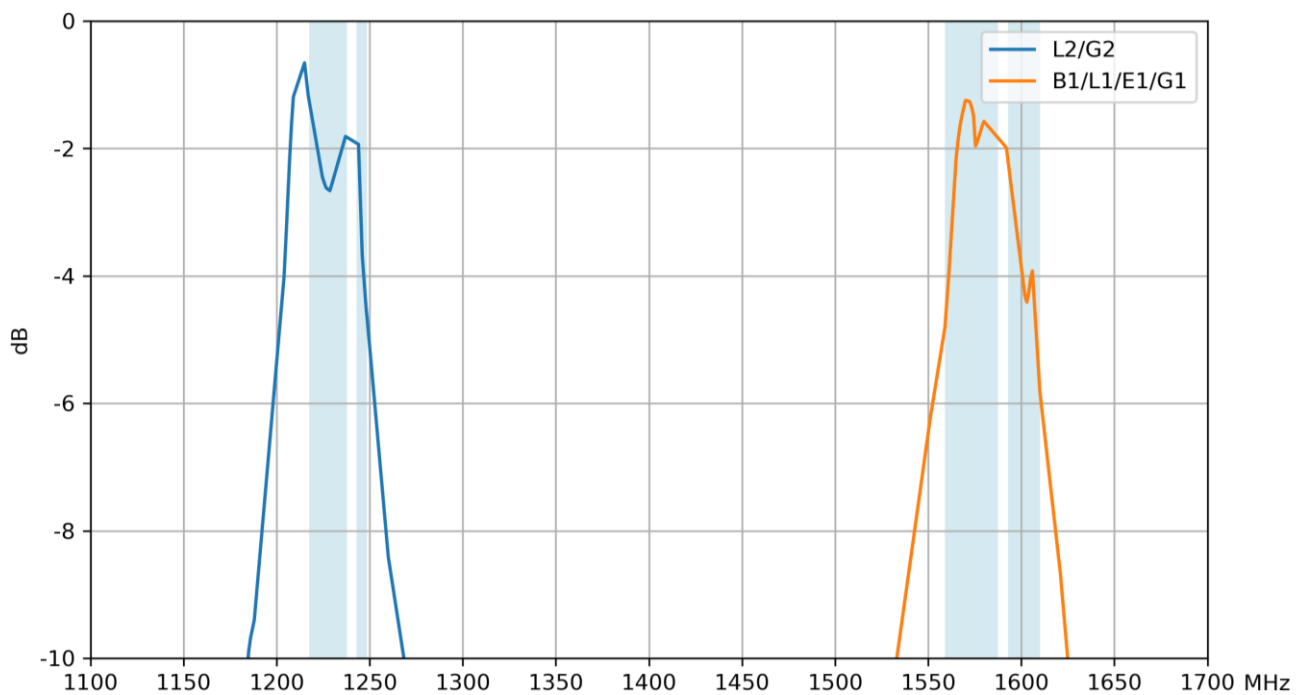
5.3 VSWR - GNSS



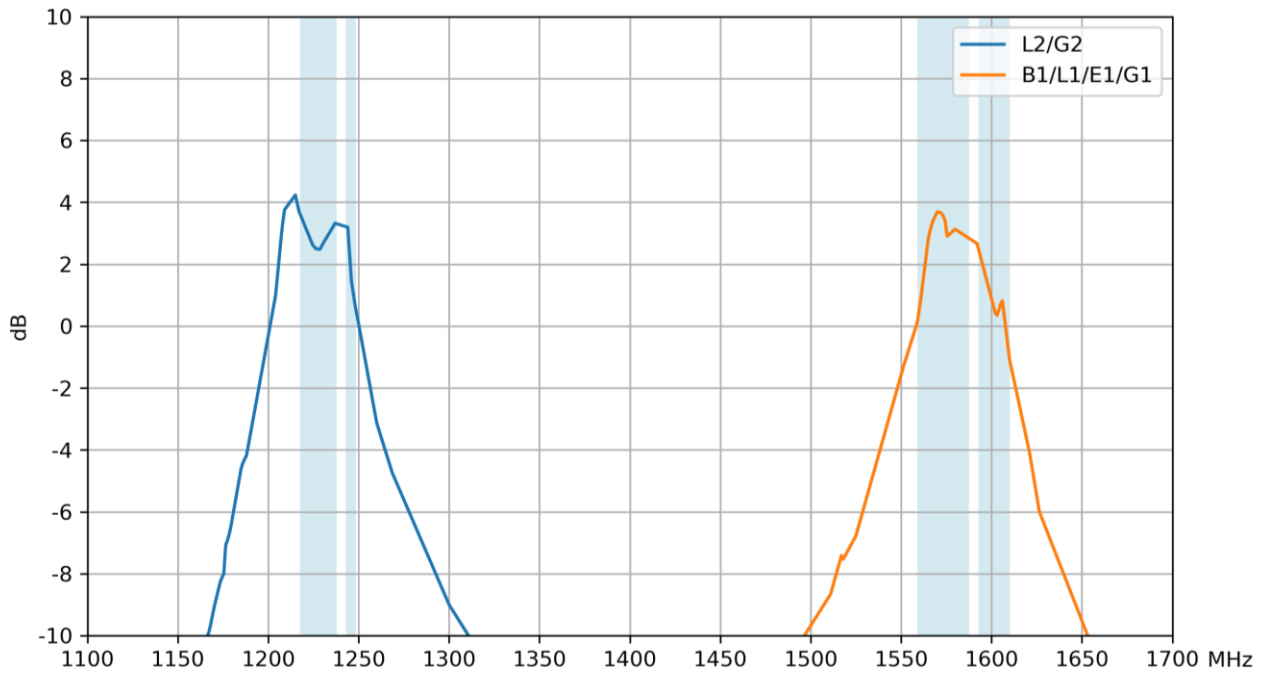
5.4 Efficiency - GNSS



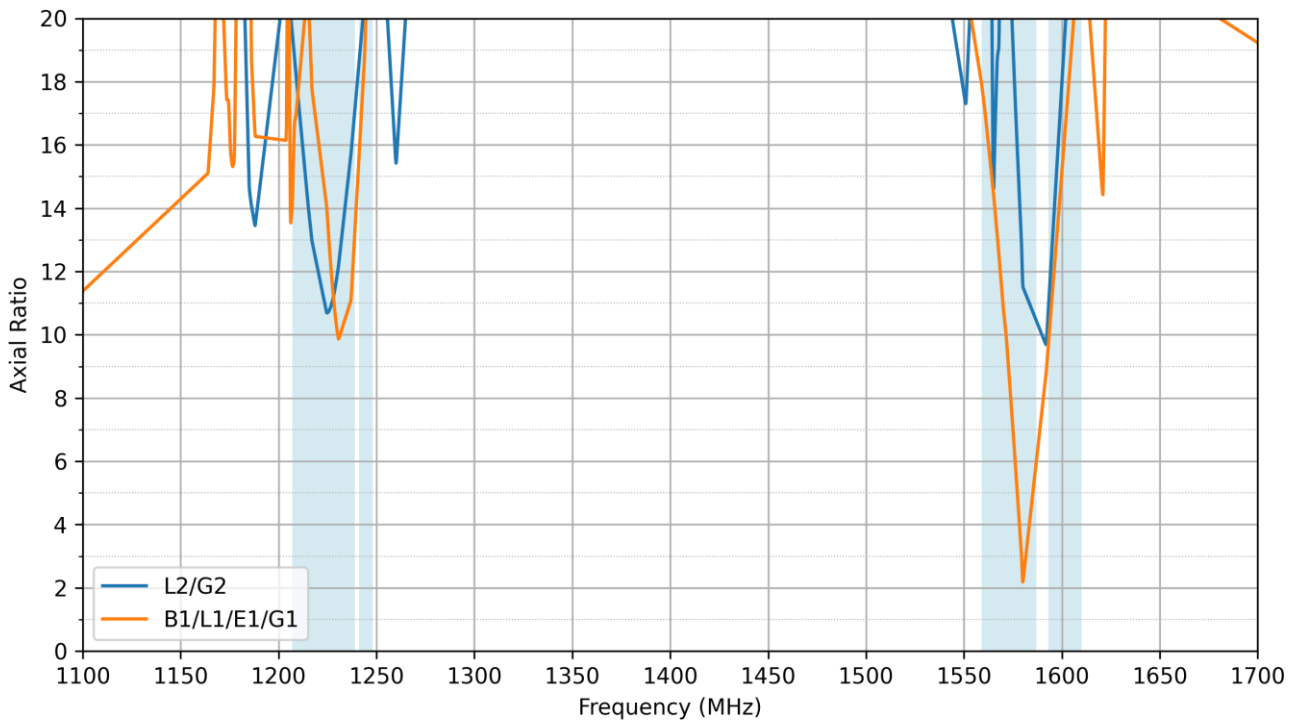
5.5 Average Gain - GNSS



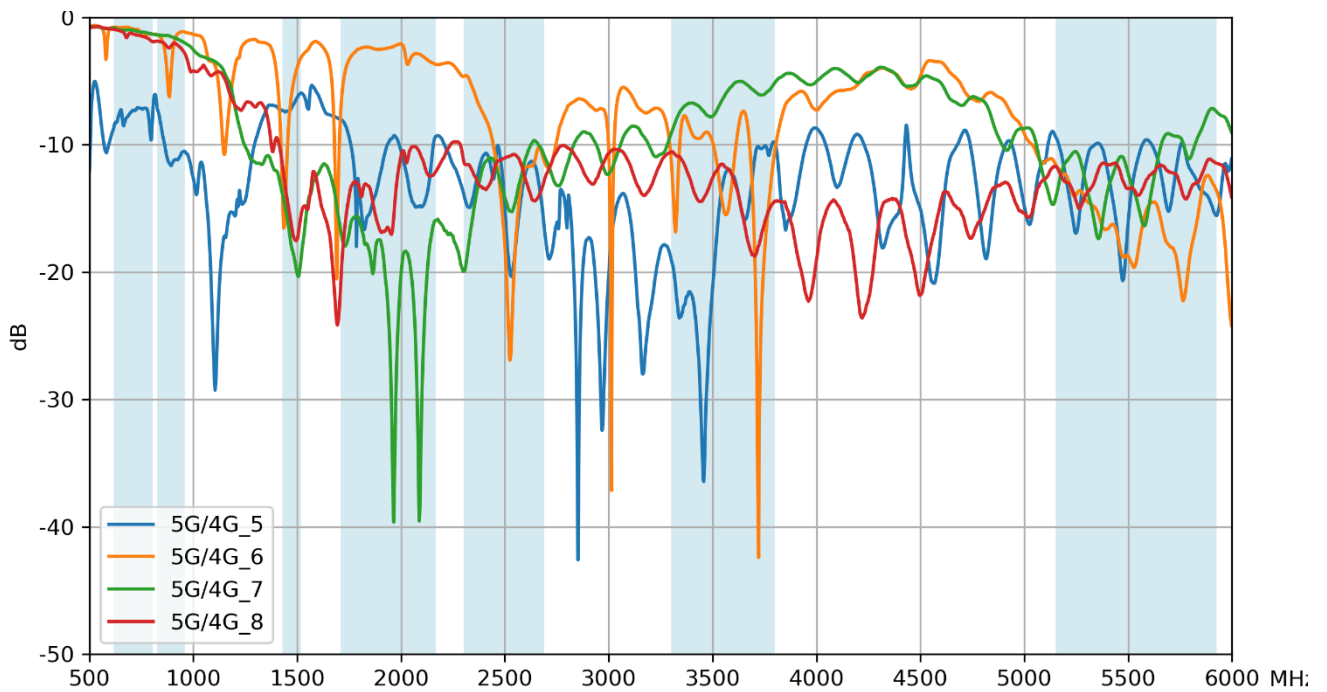
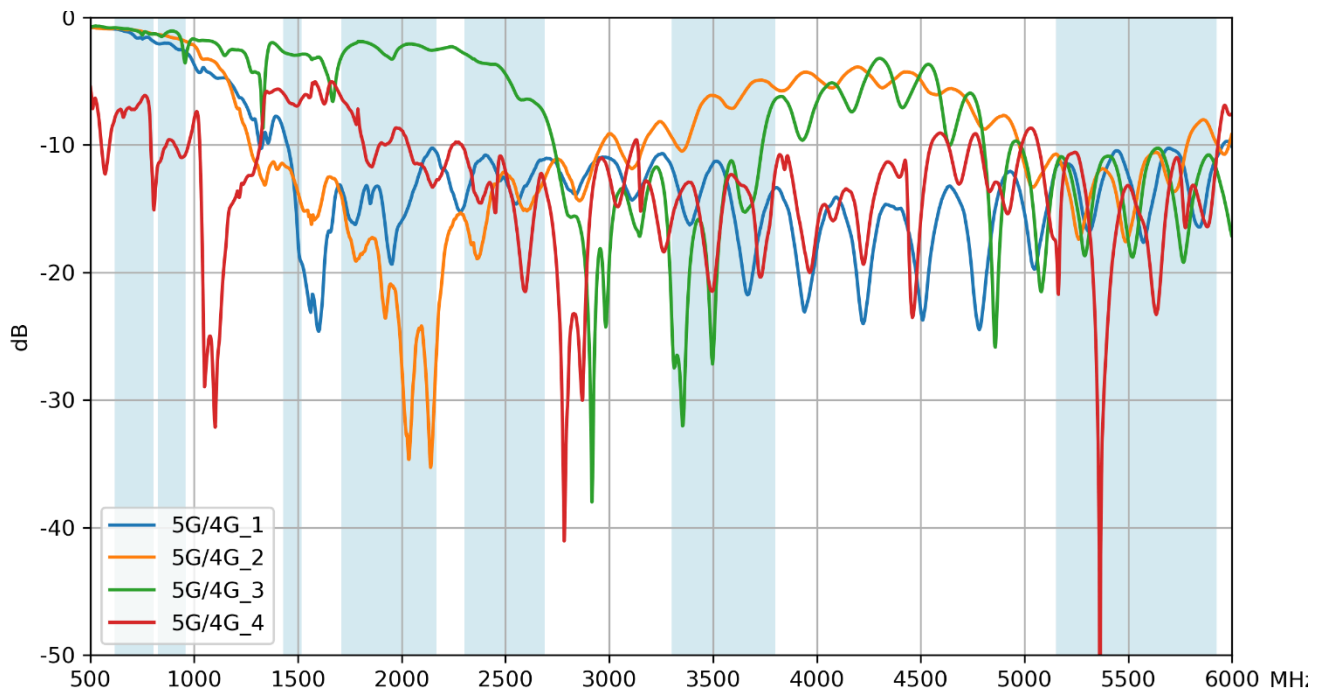
5.6 Peak Gain - GNSS



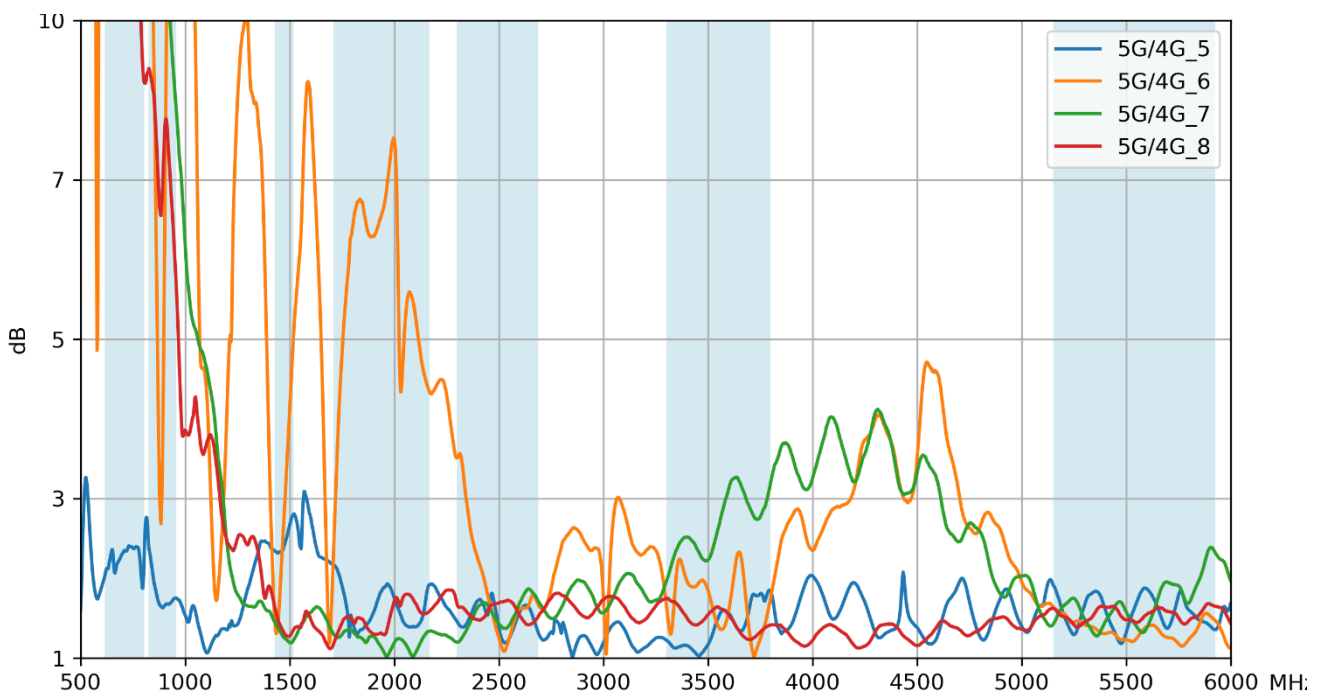
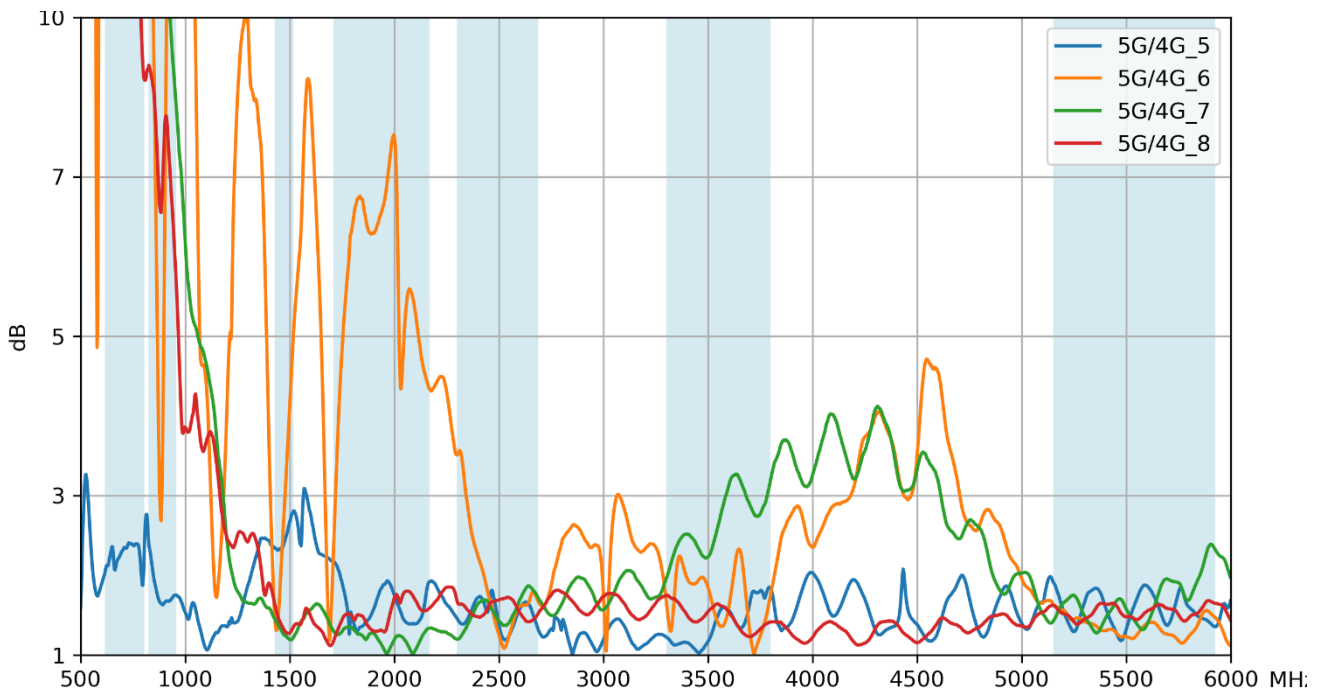
5.7 Axial Ratio - GNSS



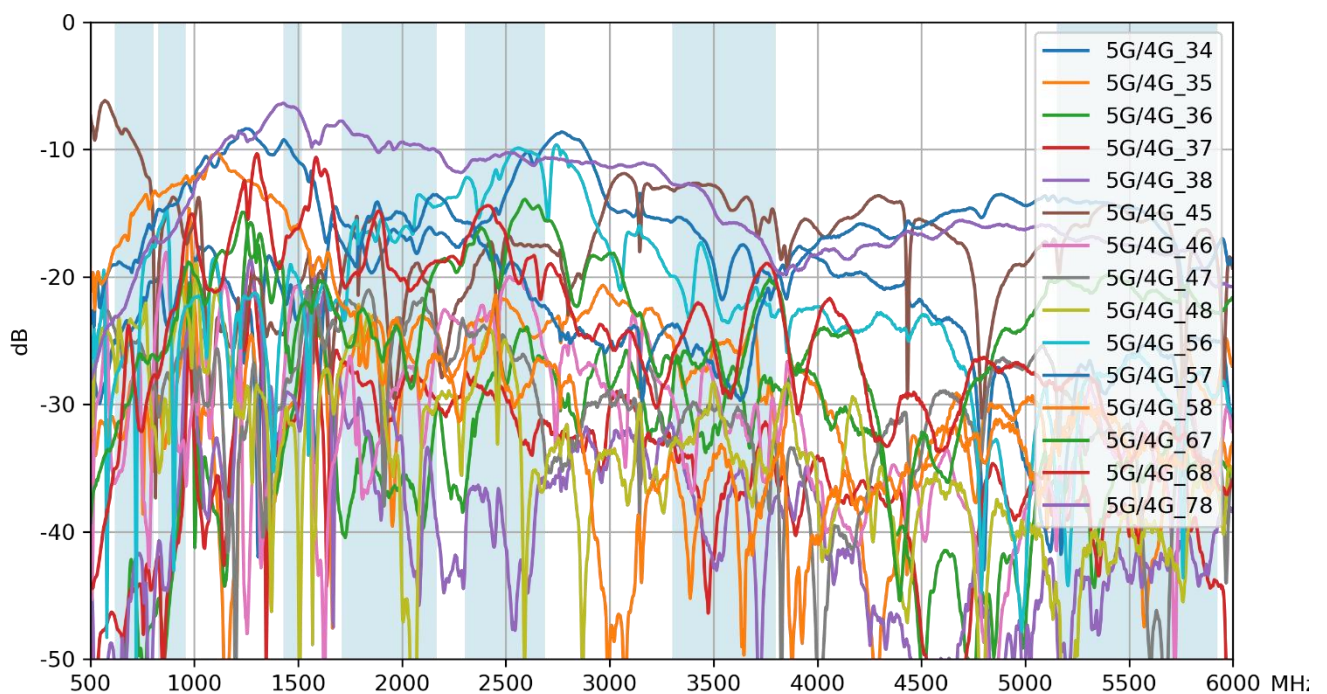
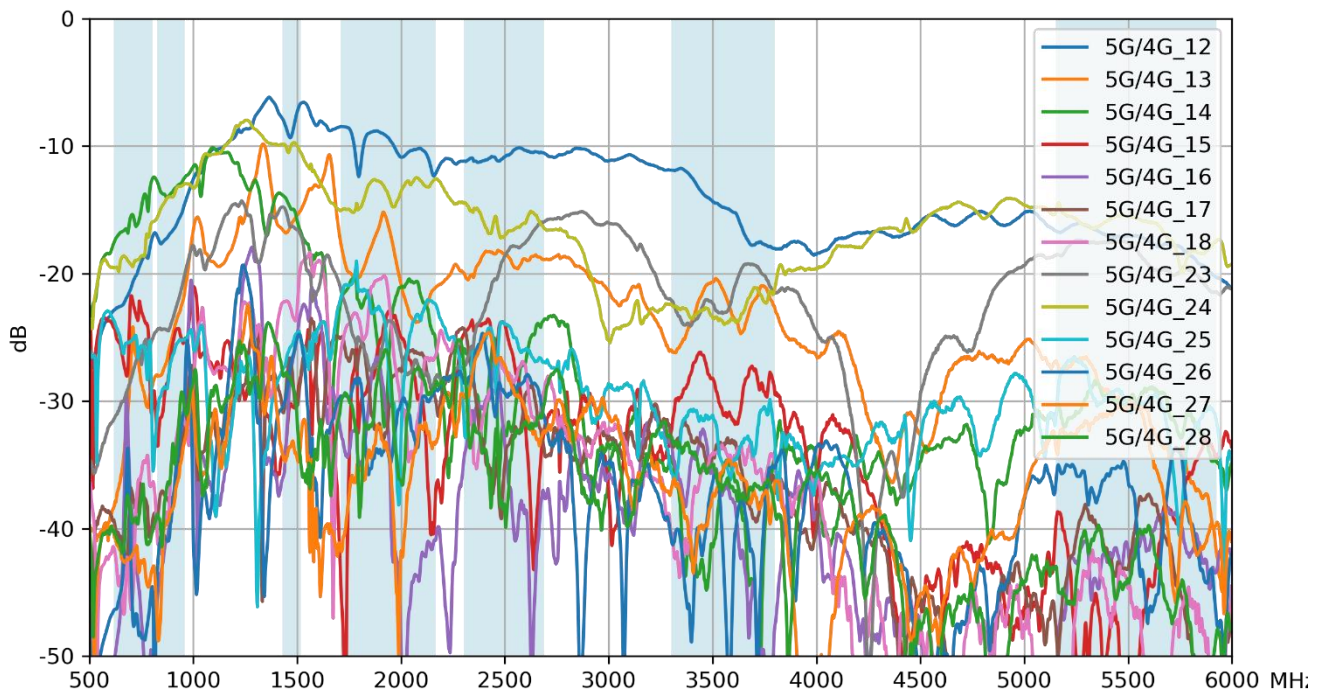
5.8 Return Loss – 5G-4G



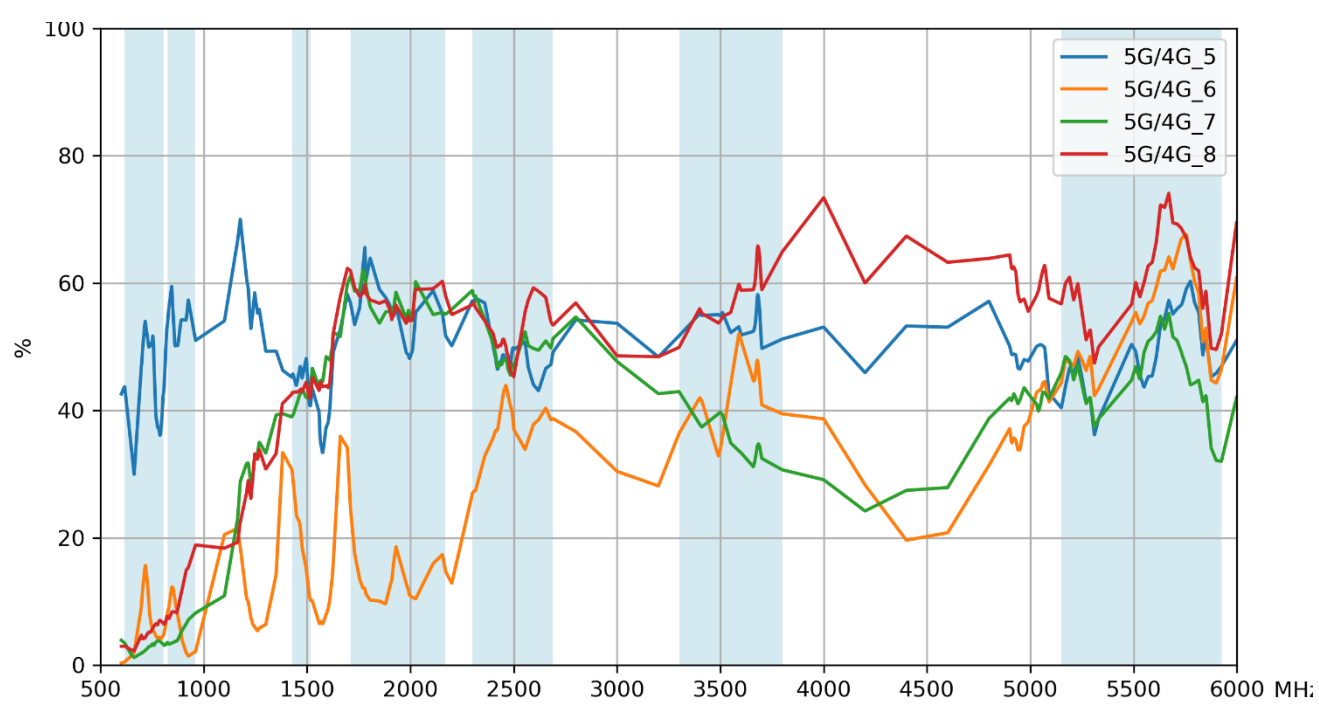
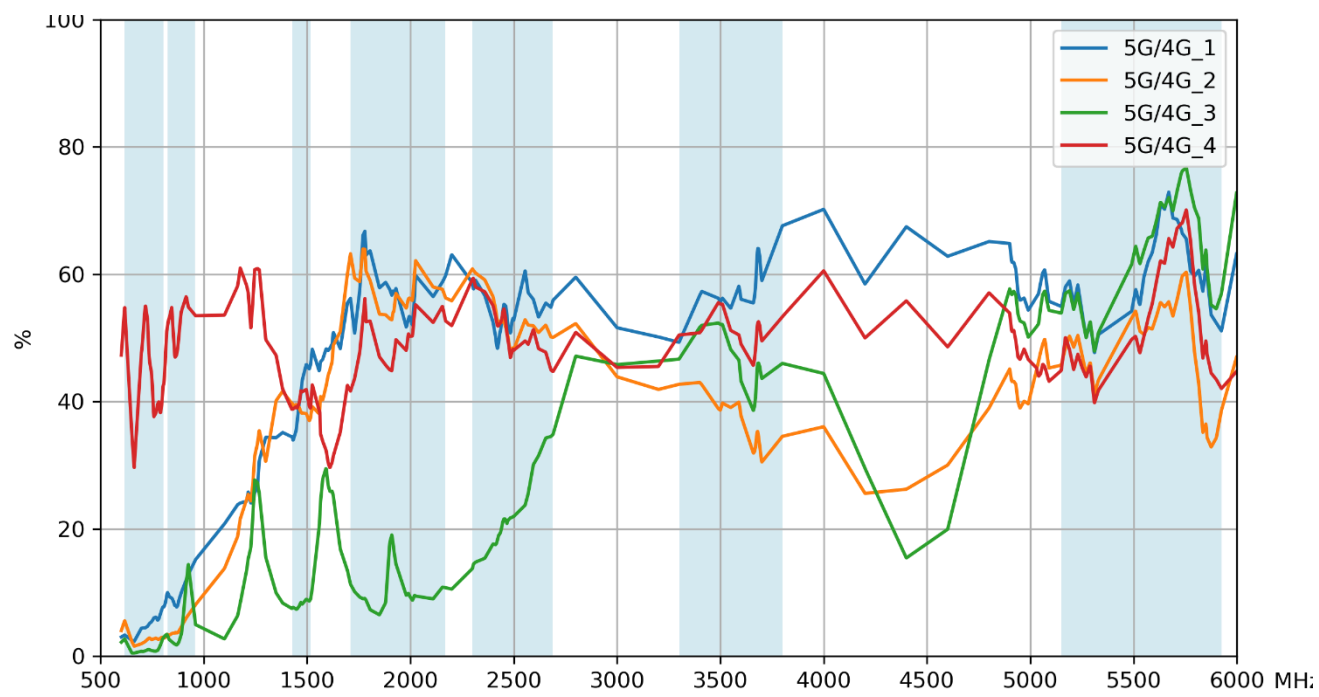
5.9 VSWR – 5G-4G



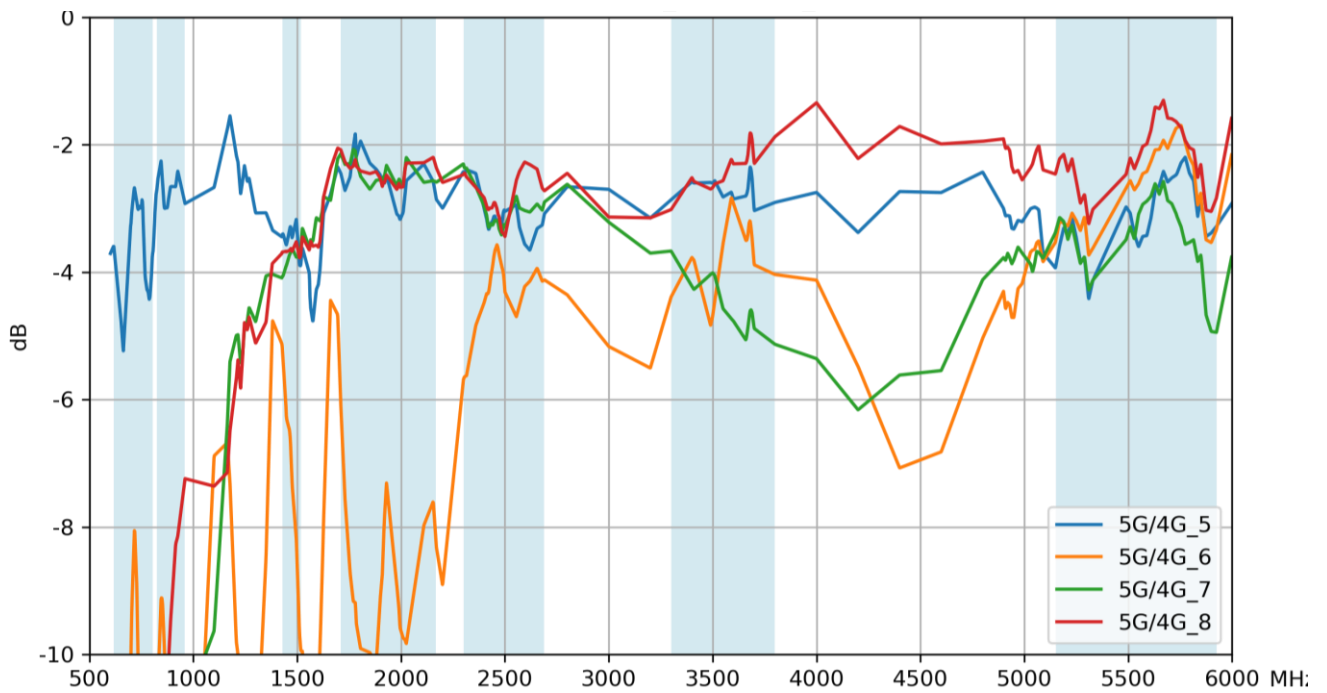
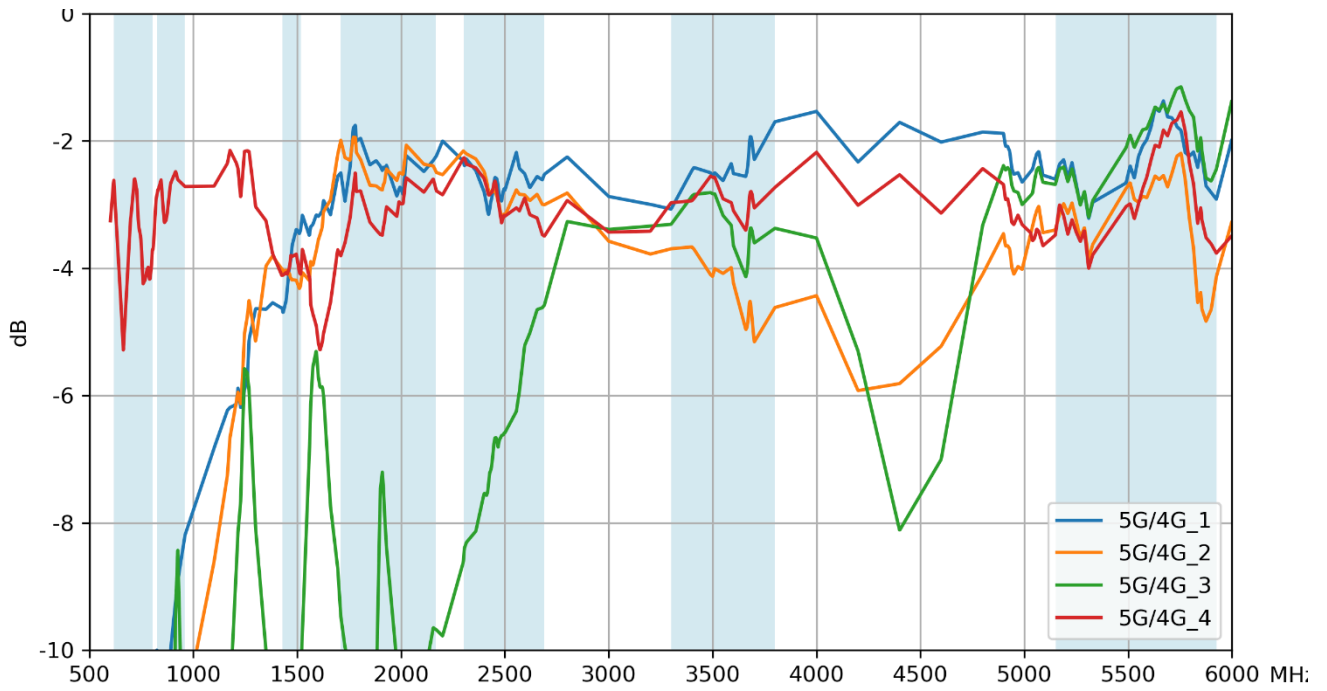
5.10 Isolation – 5G-4G



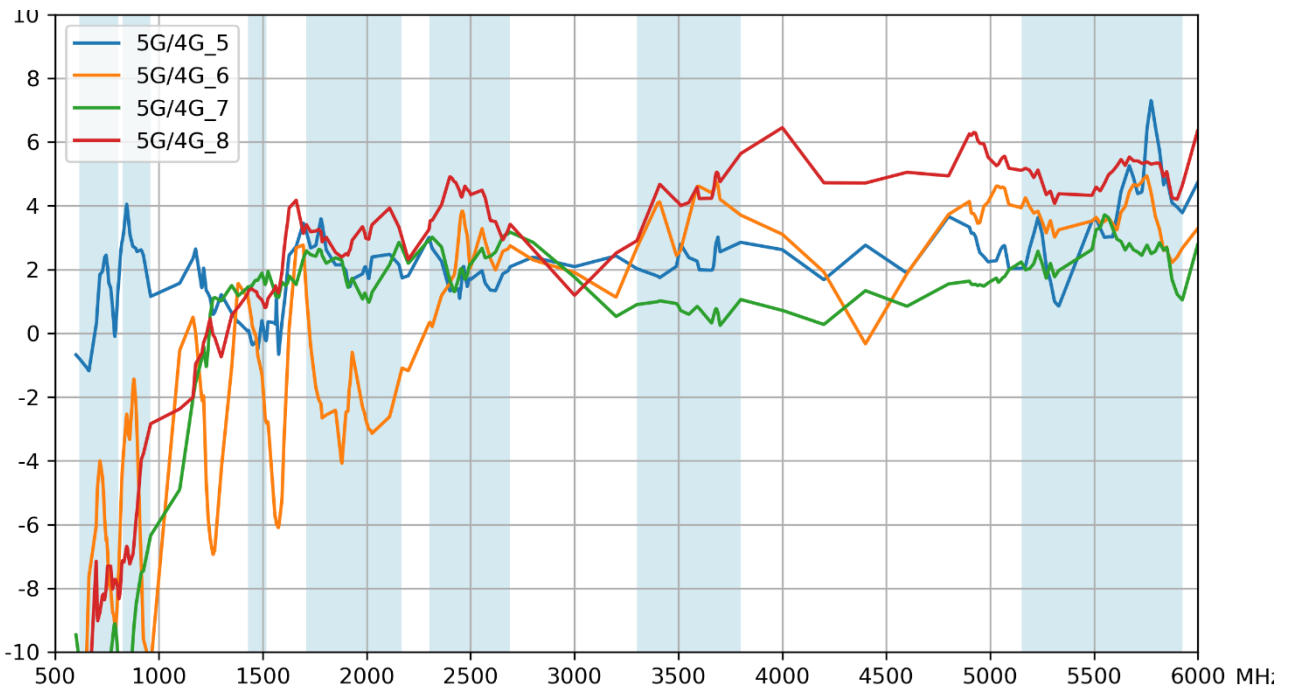
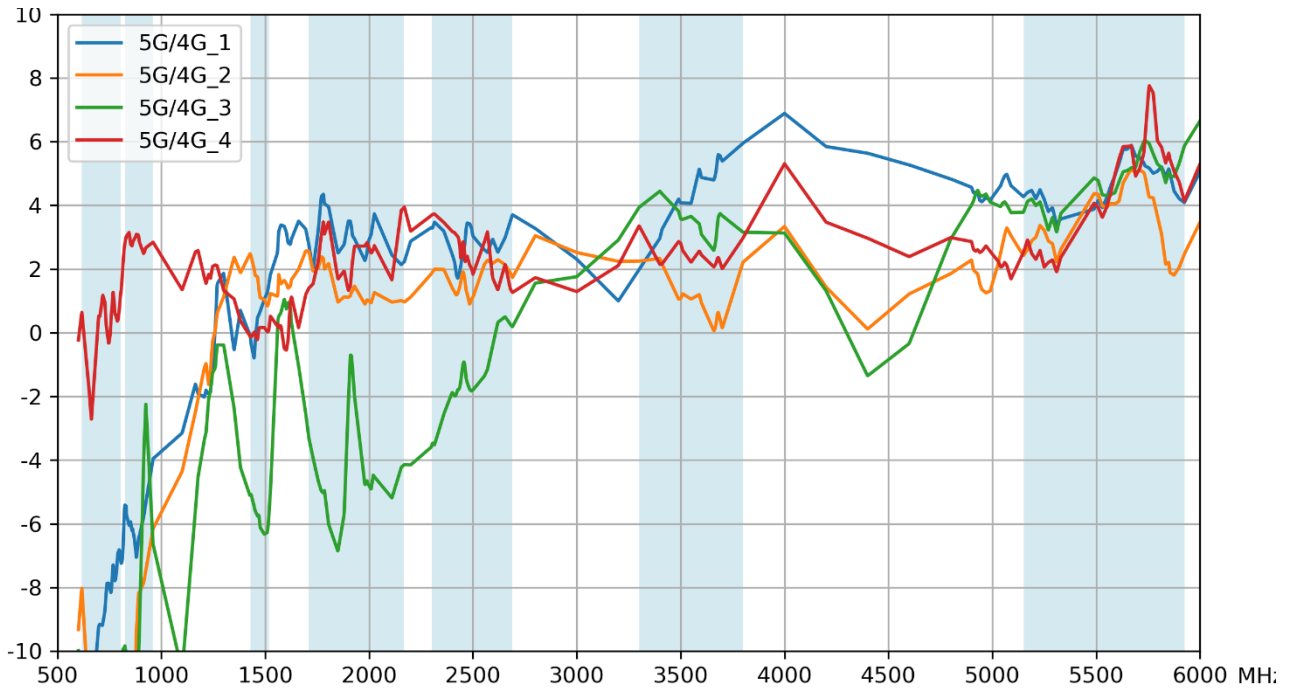
5.11 Efficiency – 5G-4G



5.12 Average Gain – 5G-4G

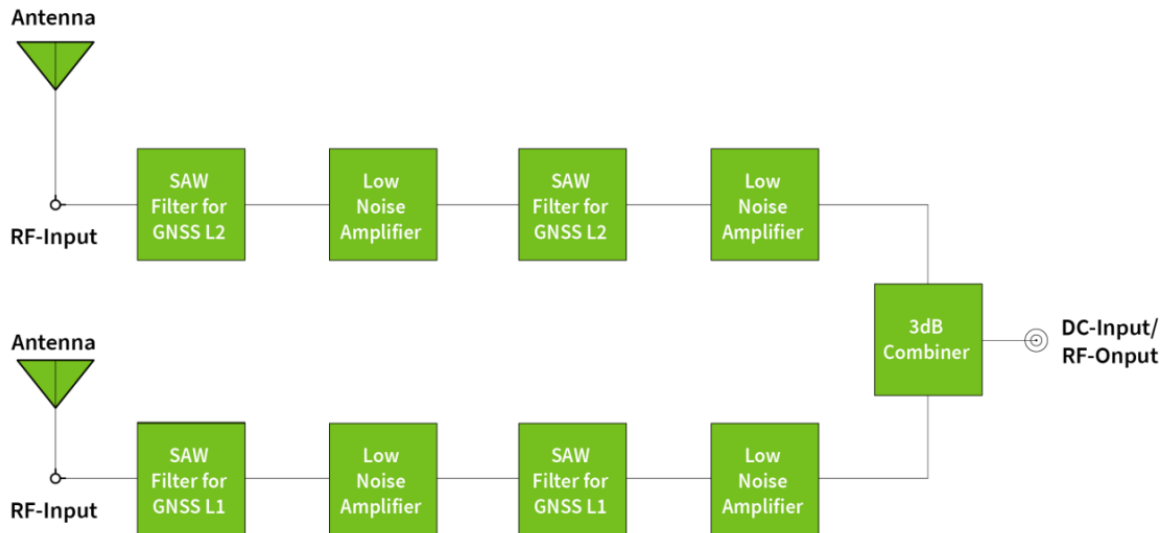


5.13 Peak Gain – 5G-4G

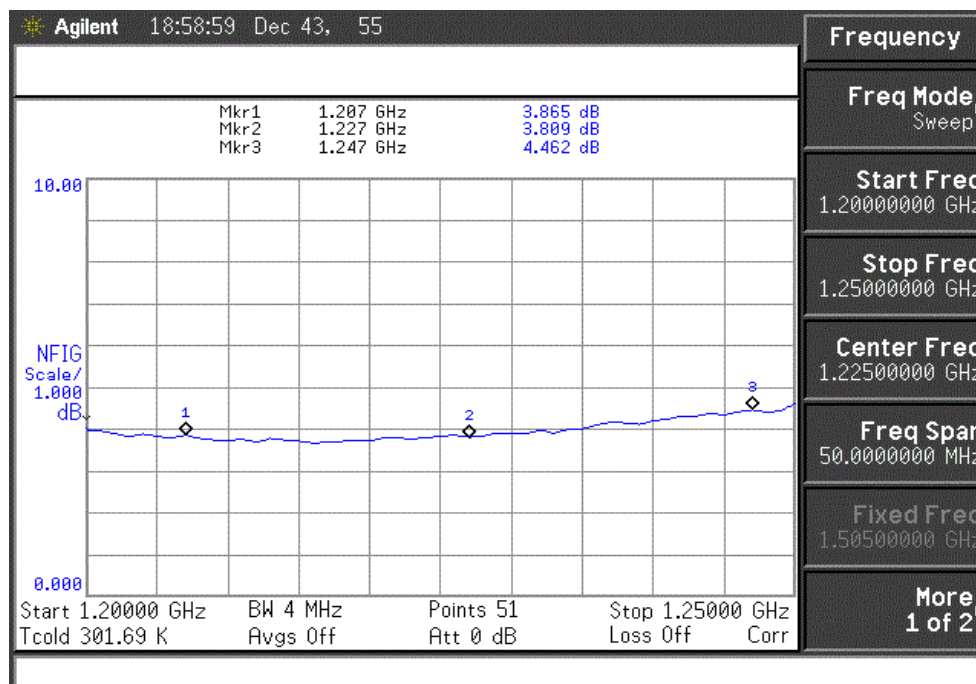


6. LNA Characteristics

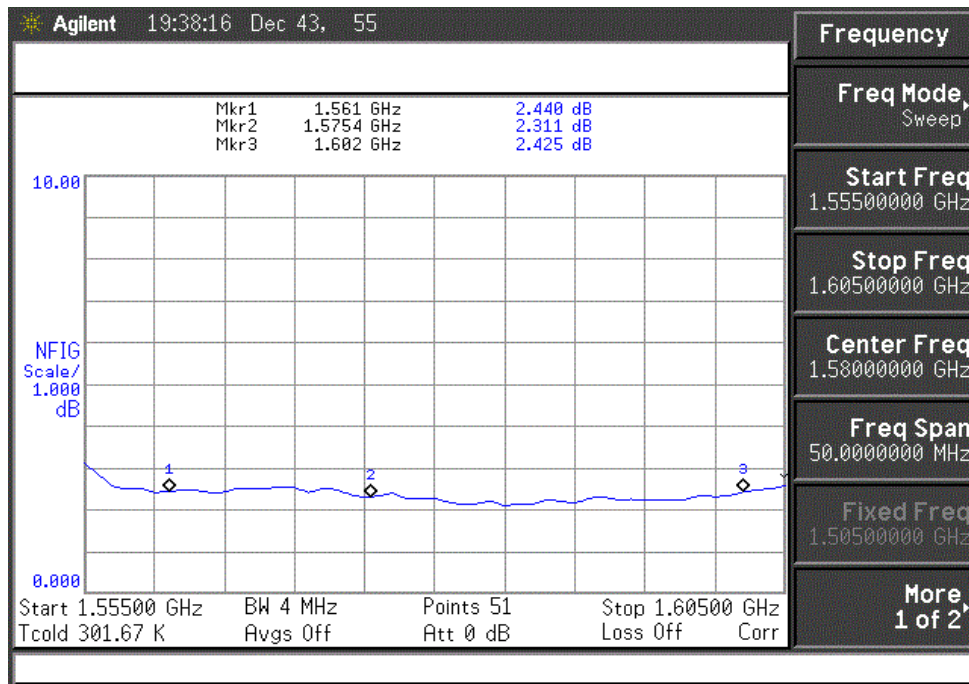
6.1 Block Diagram



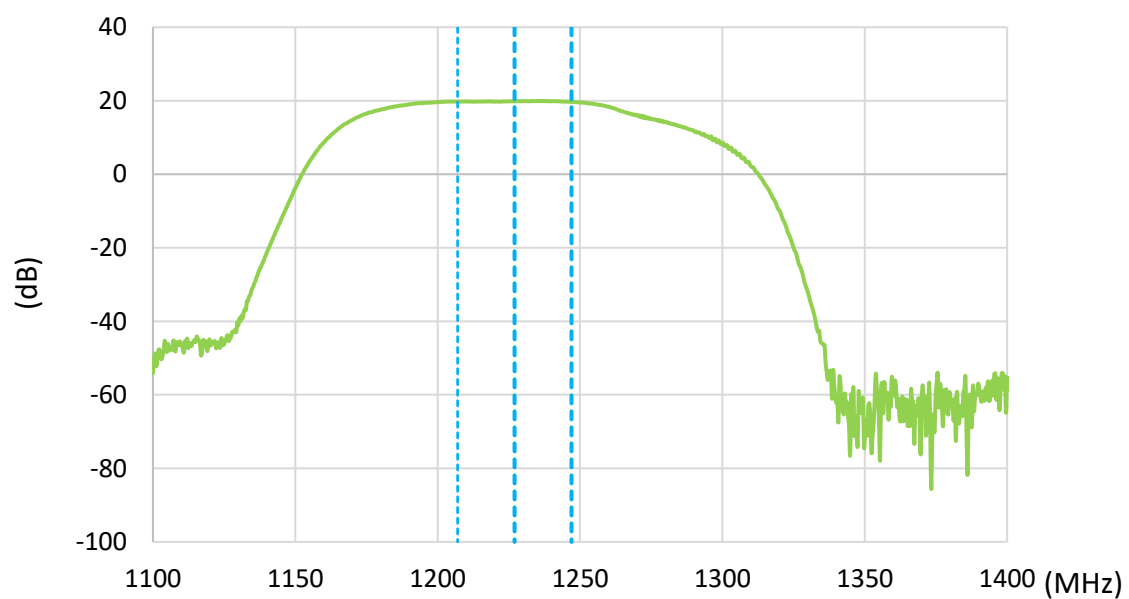
6.2 Noise Figure – Low-Band



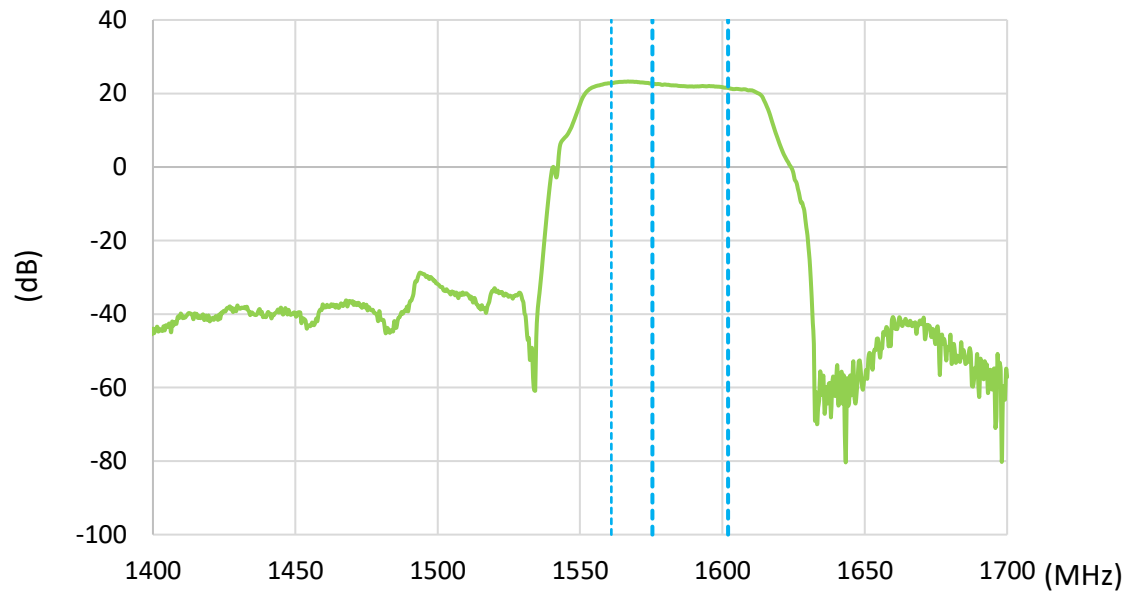
6.3 Noise Figure – High-Band



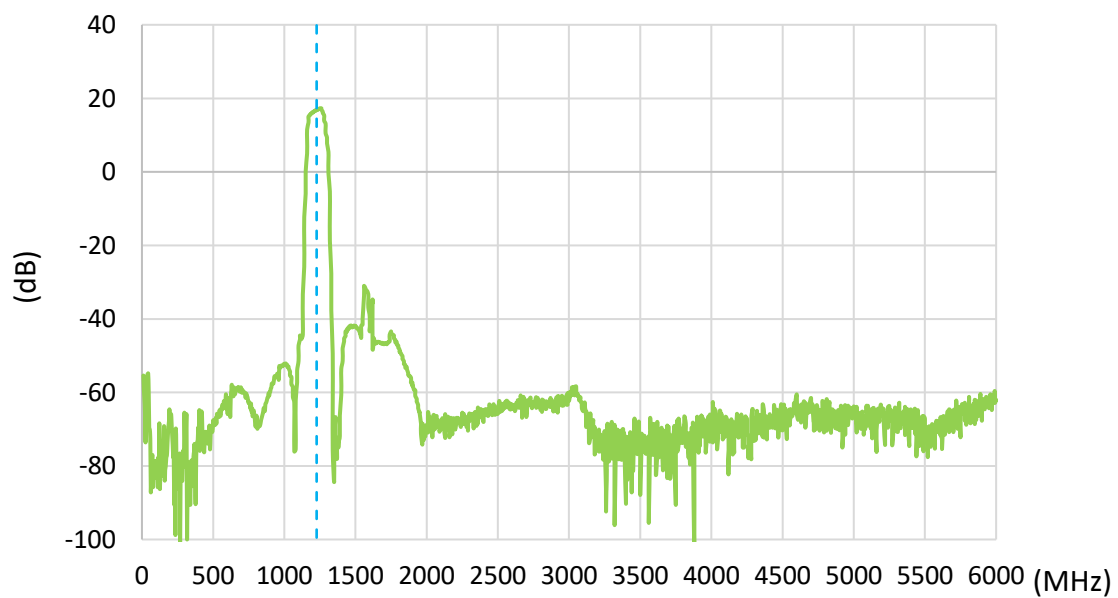
6.4 LNA Gain – Low-Band



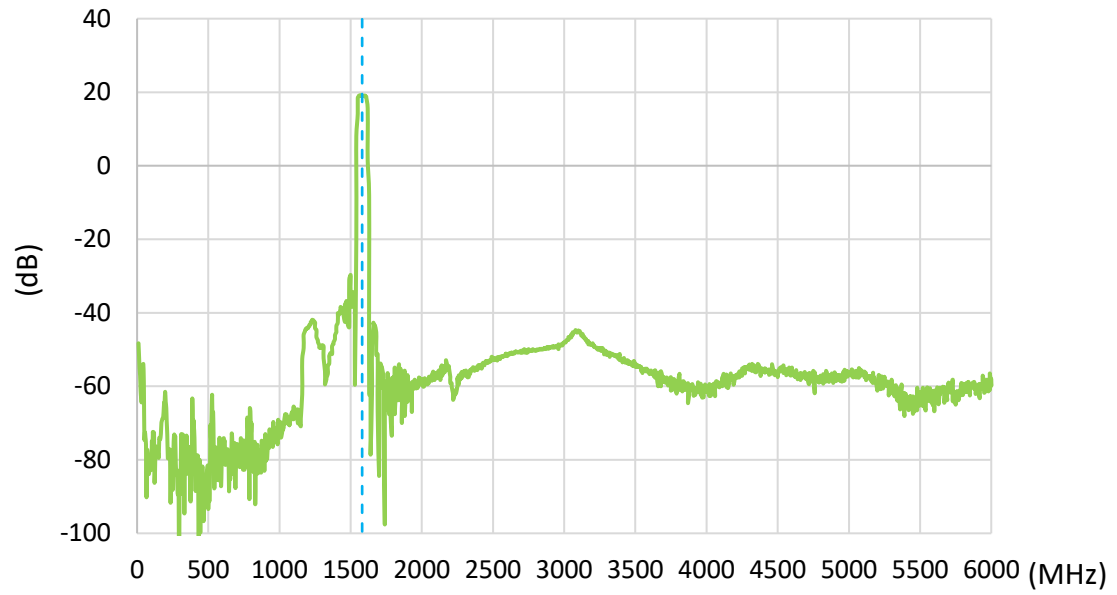
6.5 LNA Gain – High-Band



6.6 Out Of Band Rejection – Low-Band

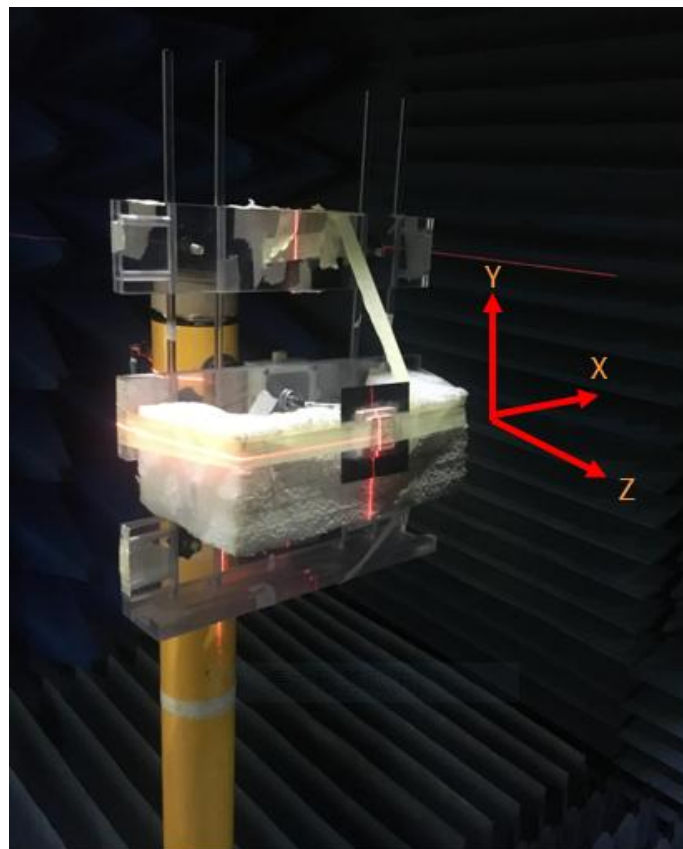
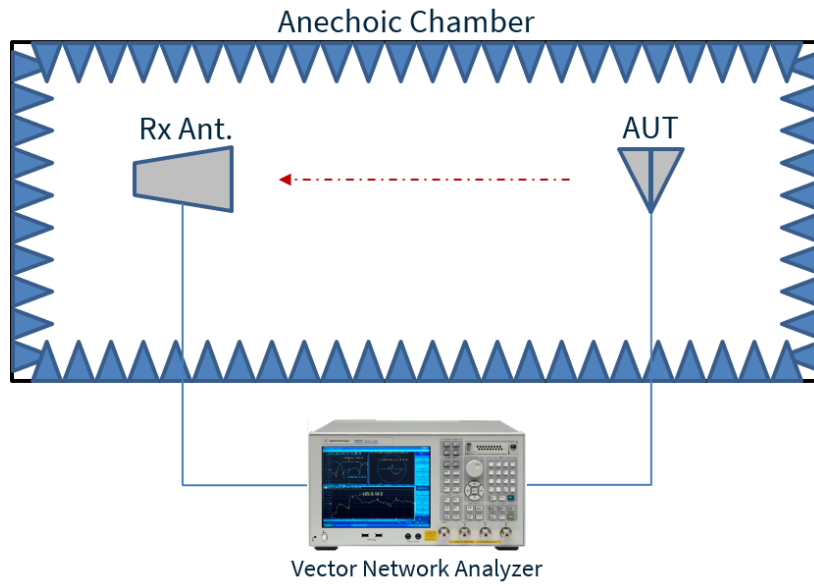


6.7 Out Of Band Rejection – High-Band



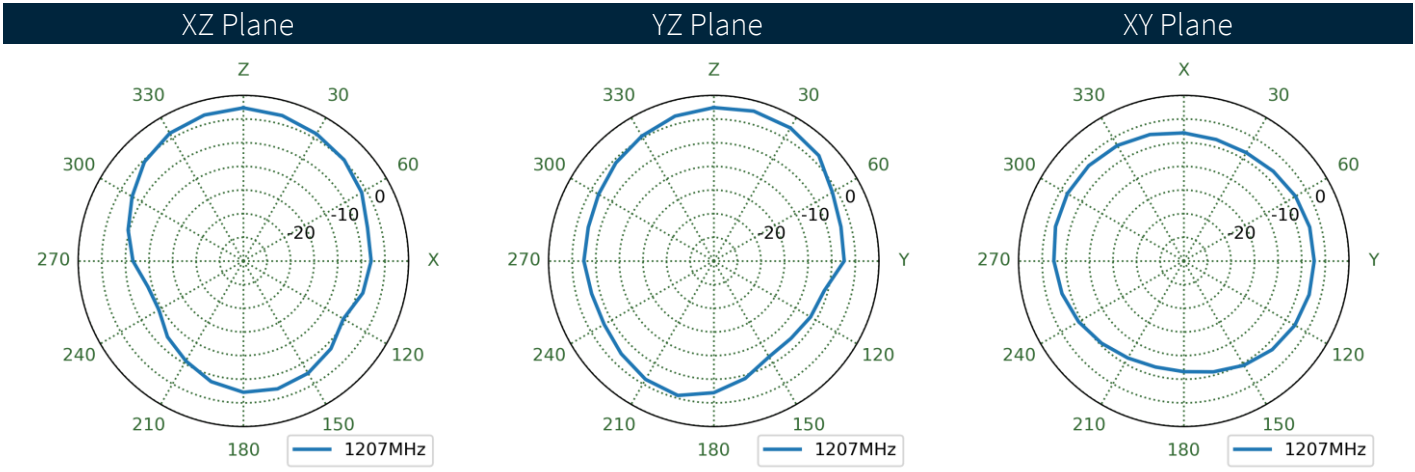
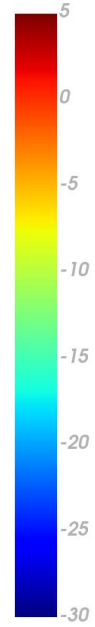
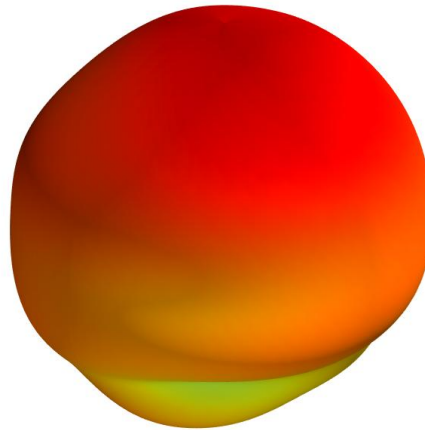
7. Radiation Patterns

7.1 Test Setup

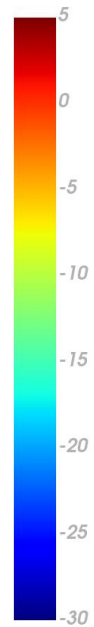
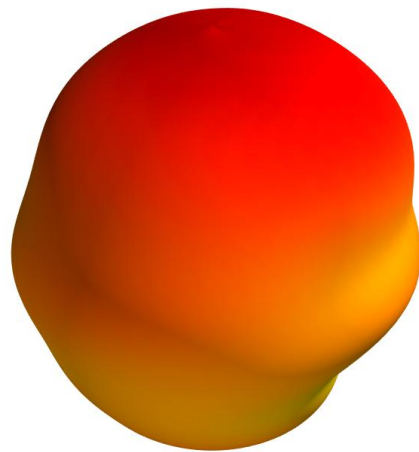


Chamber Test Set-up

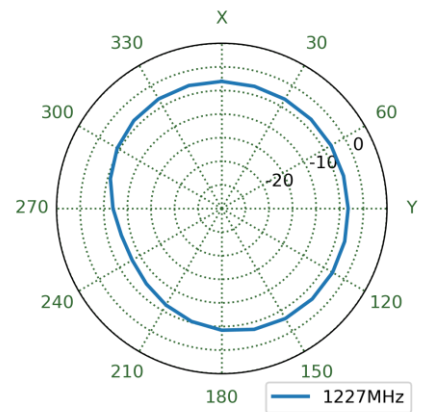
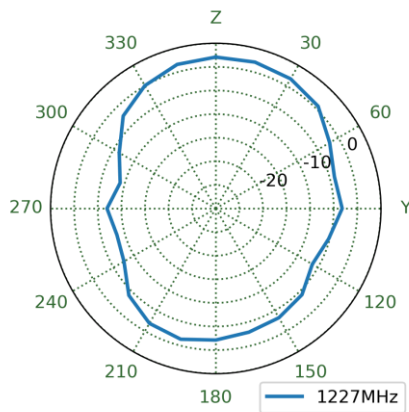
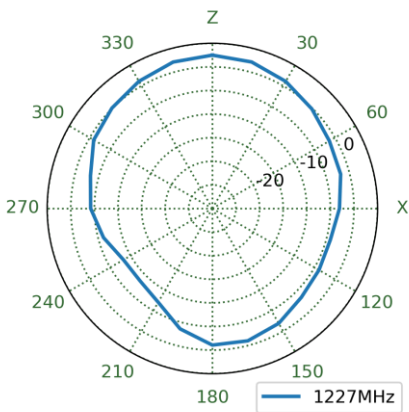
7.2 GNSS Patterns at 1207 MHz



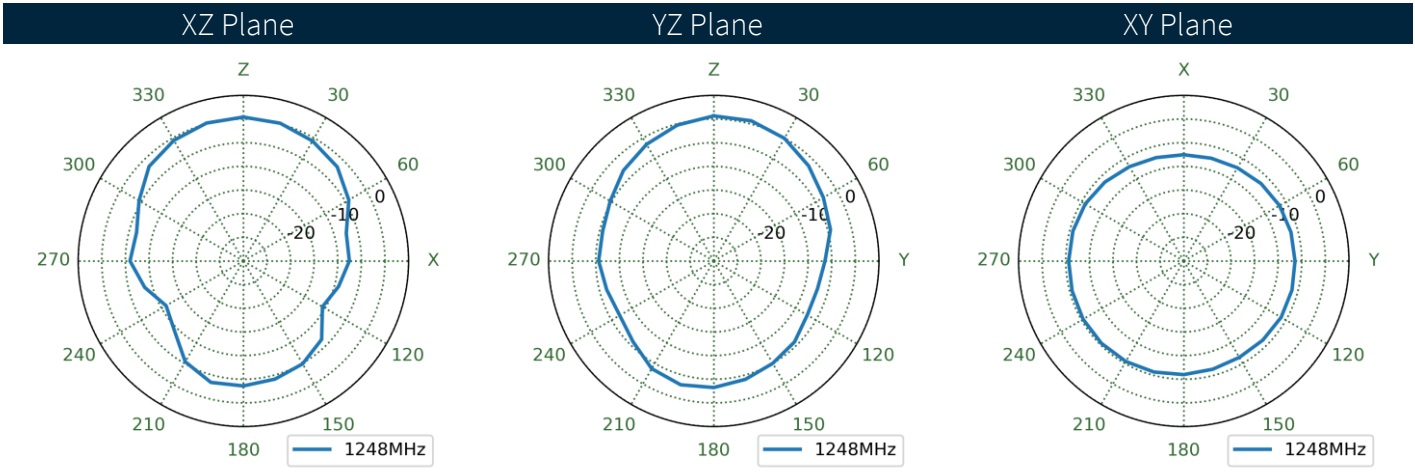
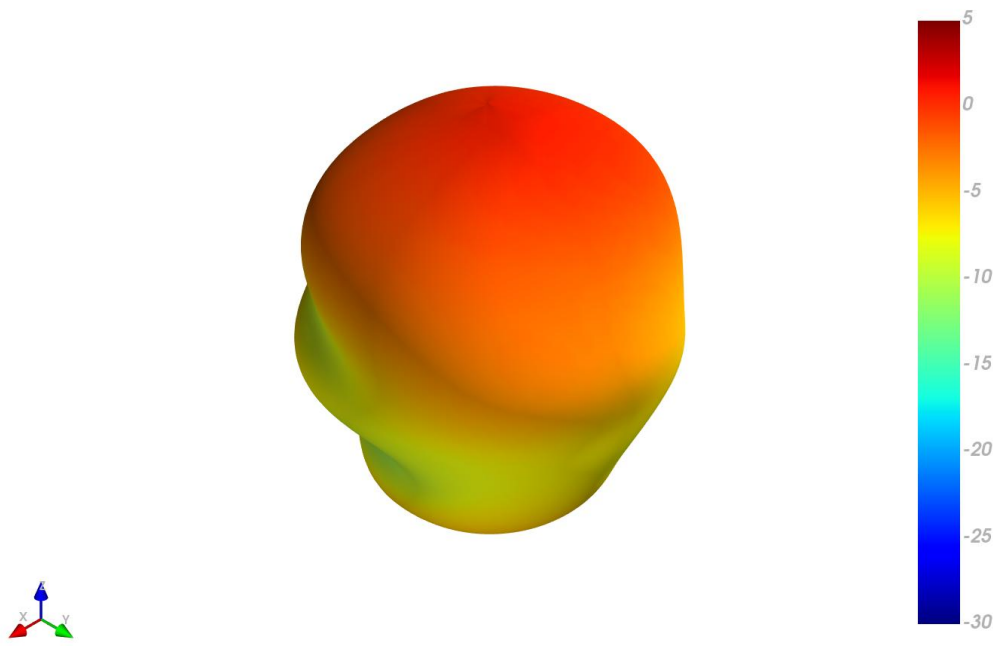
7.3 GNSS Patterns at 1227 MHz



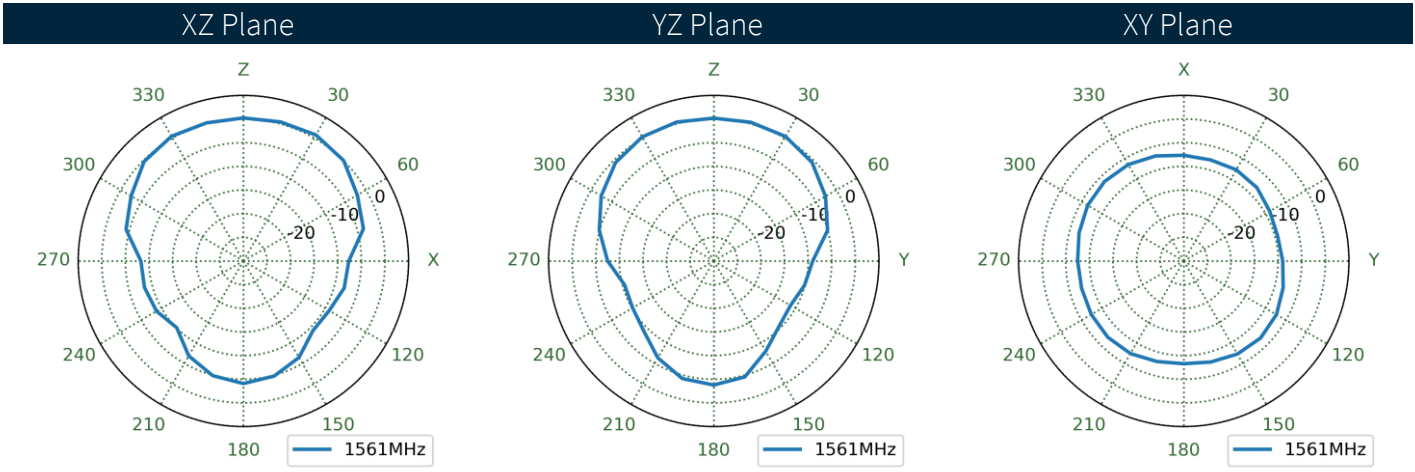
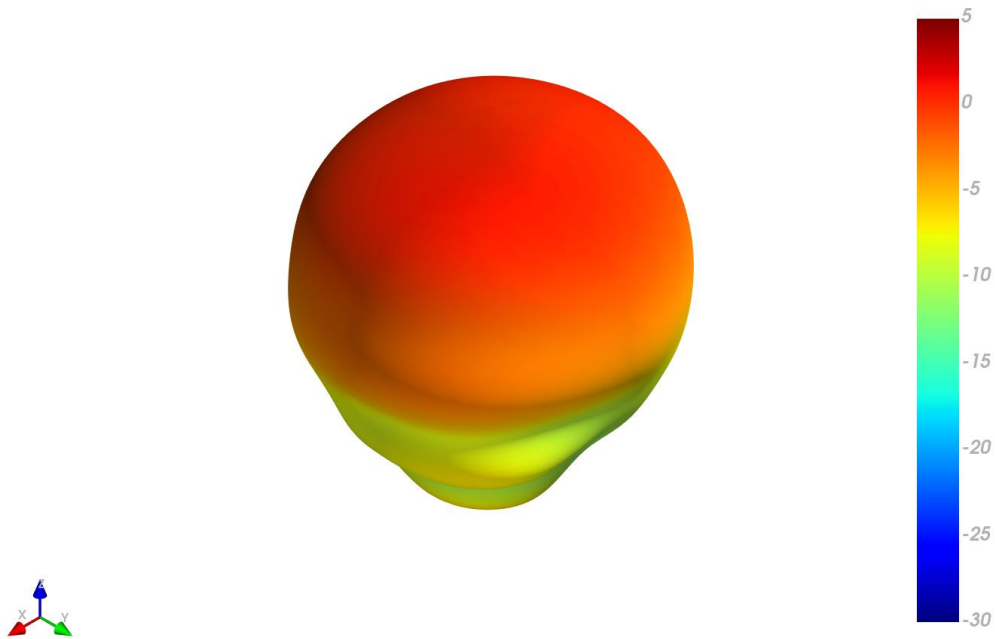
XZ Plane YZ Plane XY Plane



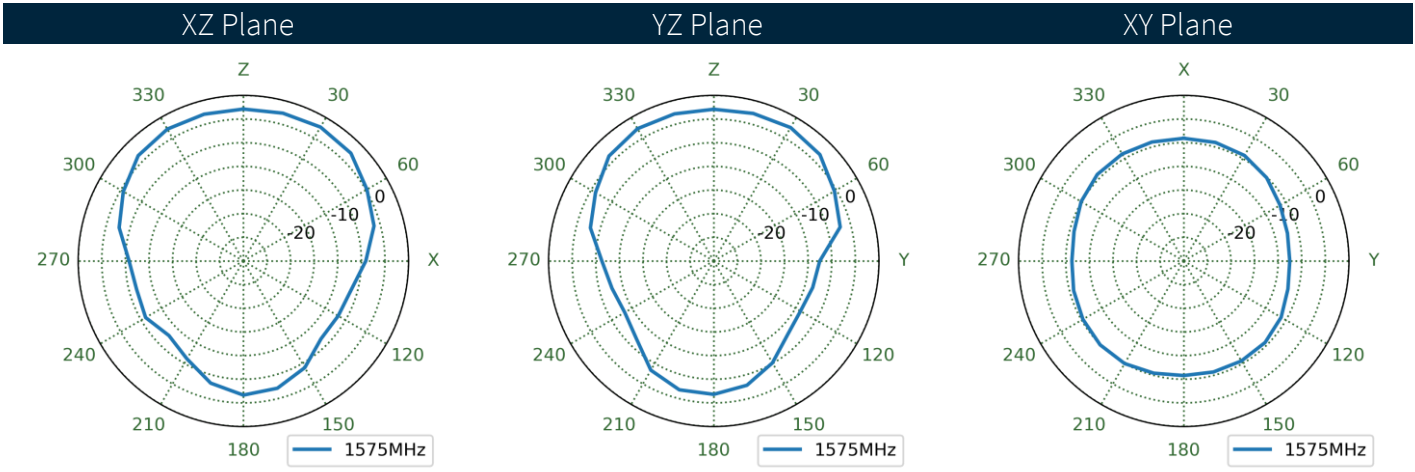
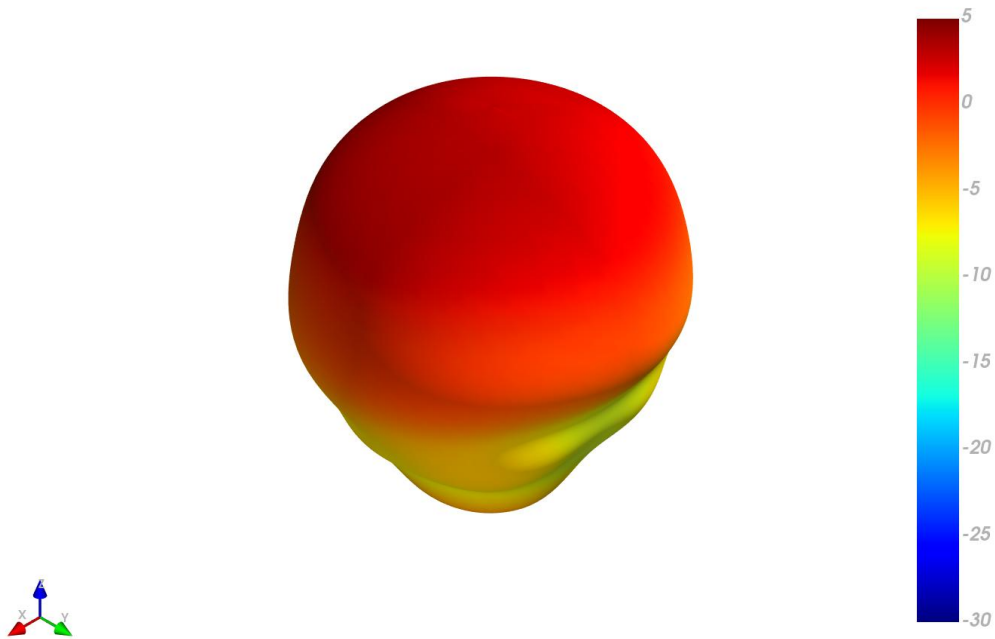
7.4 GNSS Patterns at 1248 MHz



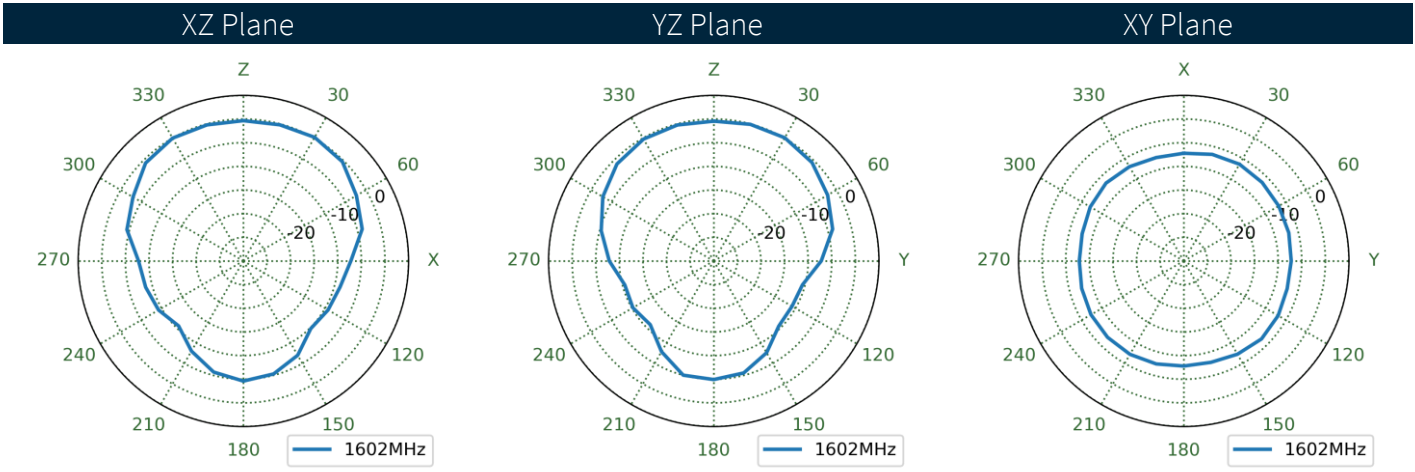
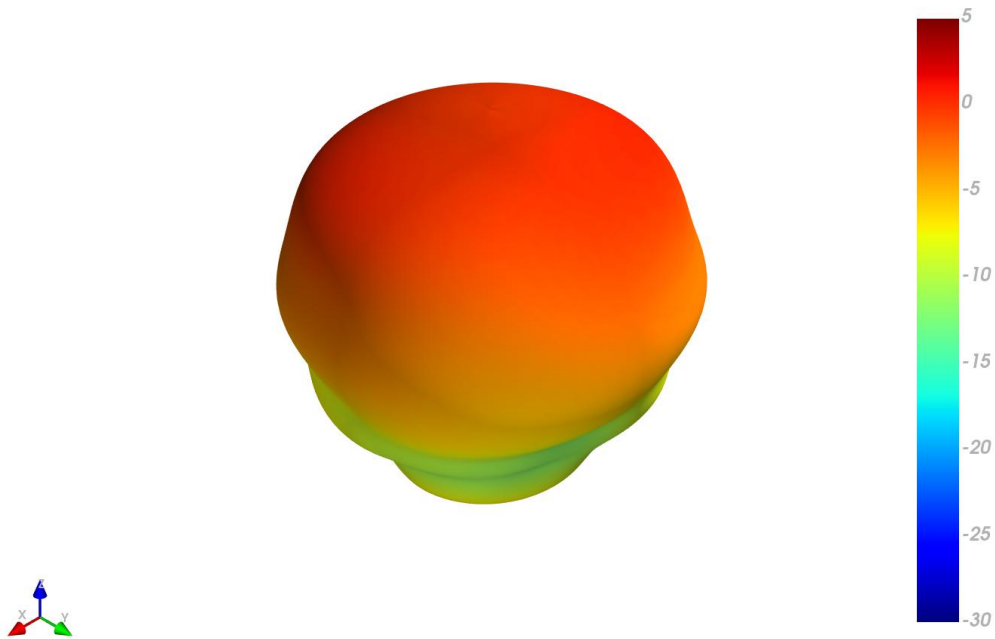
7.5 GNSS Patterns at 1561 MHz



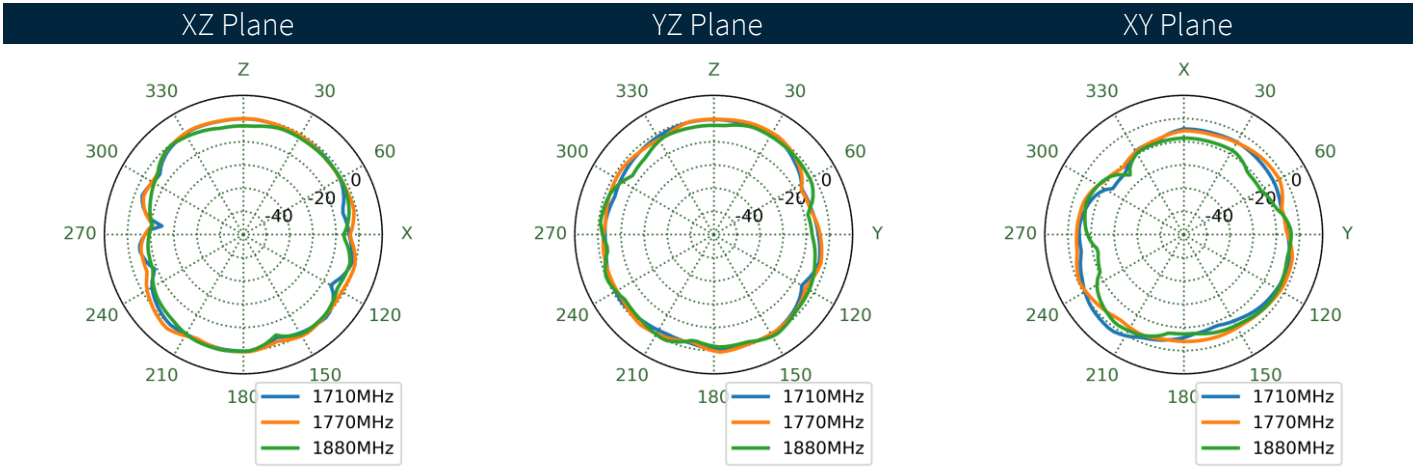
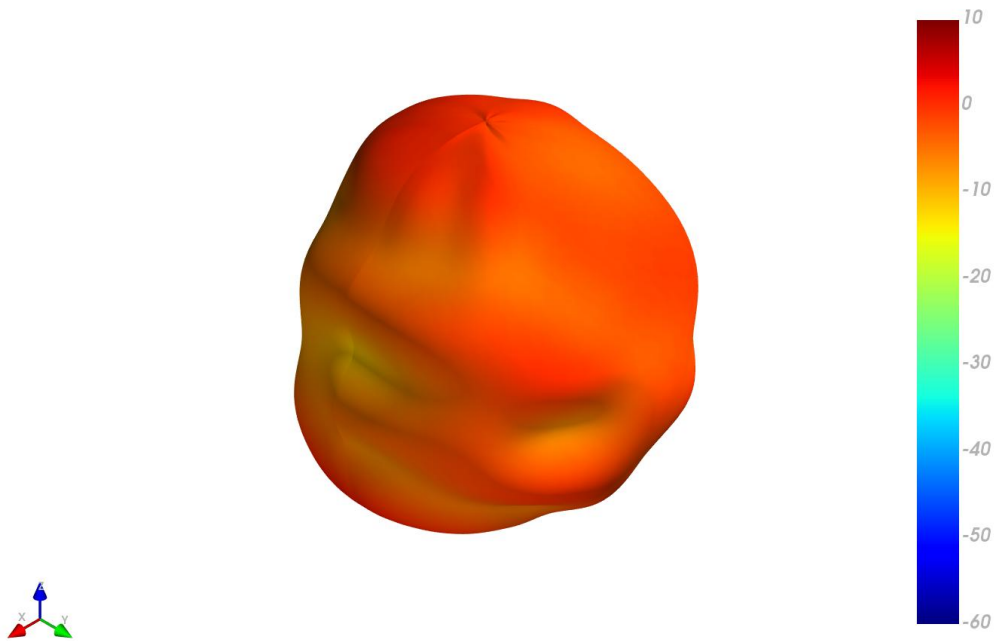
7.6 GNSS Patterns at 1575 MHz



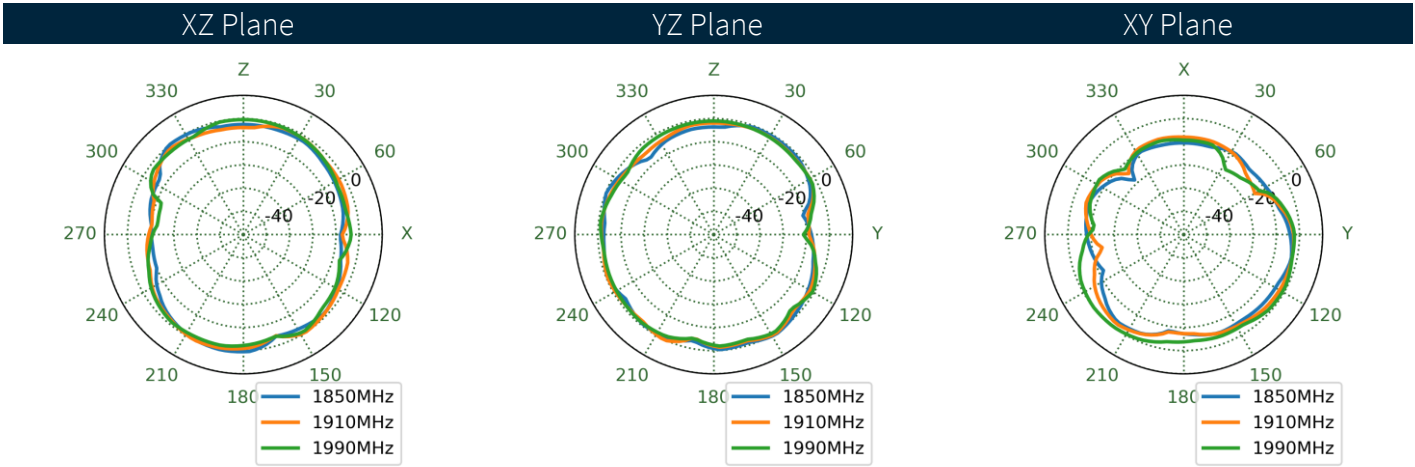
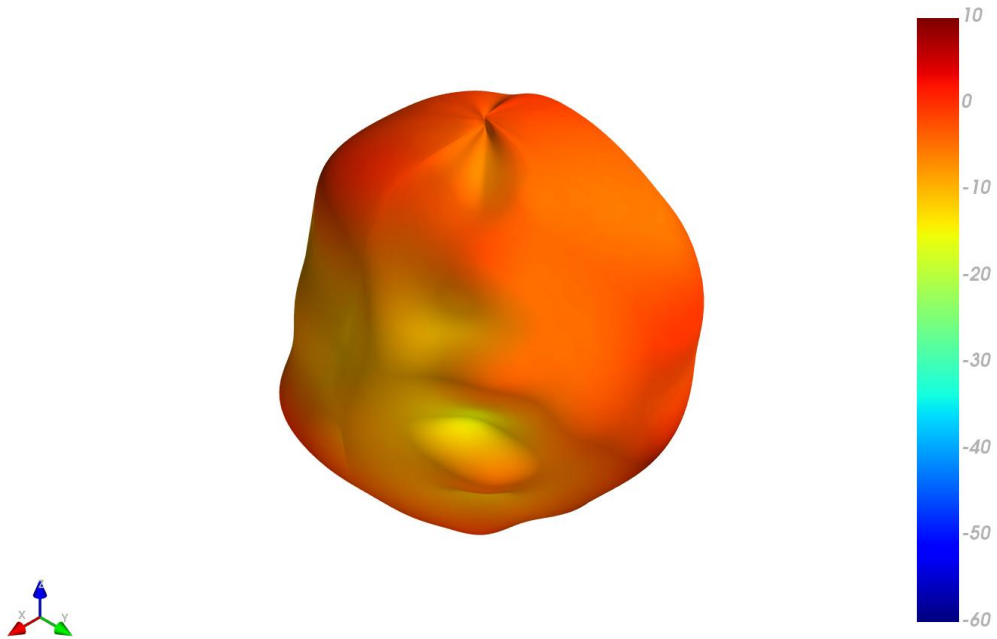
7.7 GNSS Patterns at 1602 MHz



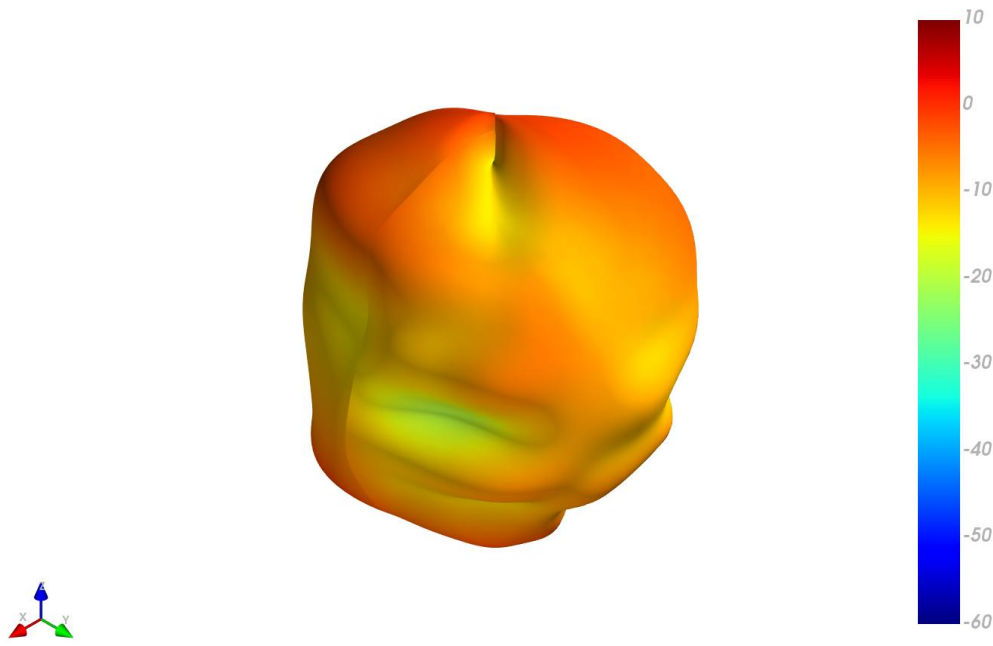
7.8 5G-4G-1 Patterns at 1770 MHz



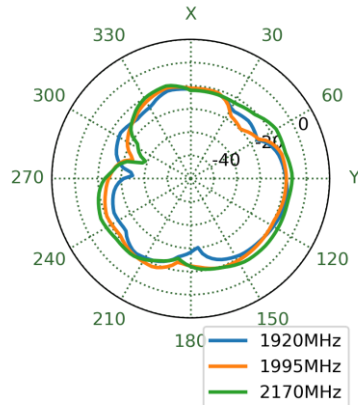
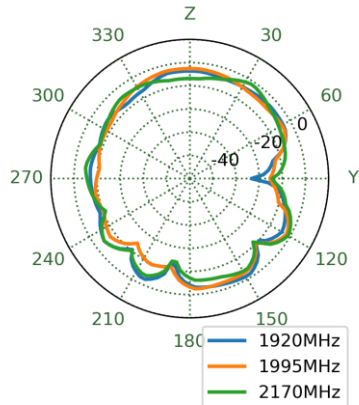
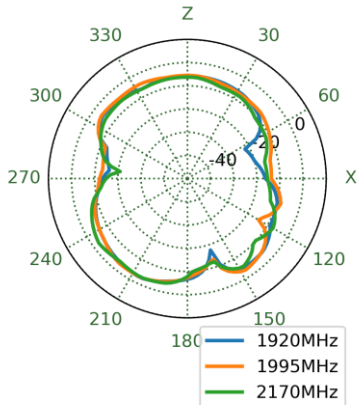
7.9 5G-4G-1 Patterns at 1910 MHz



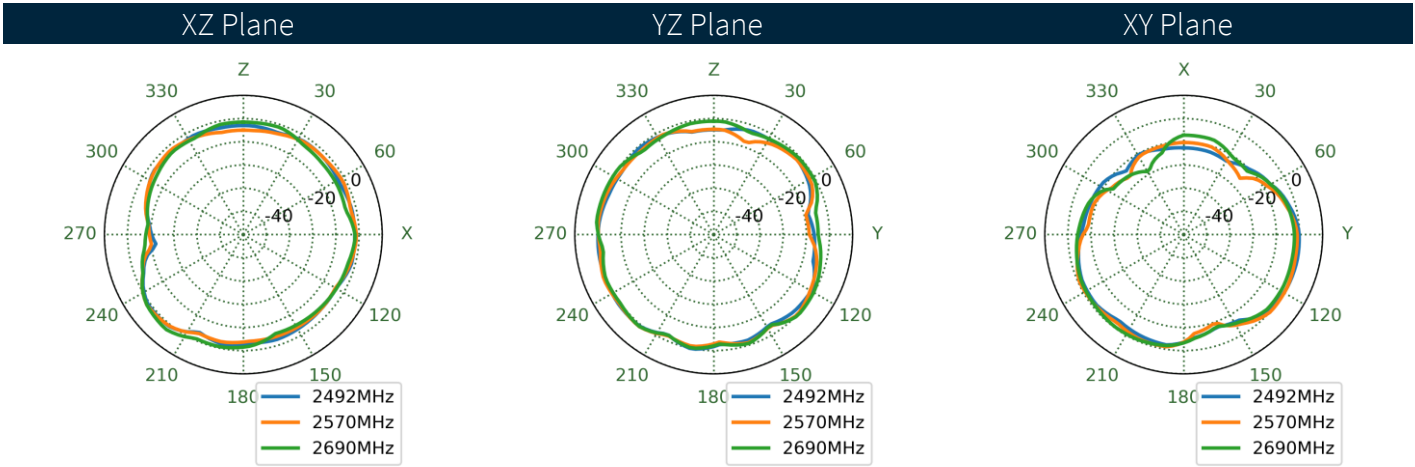
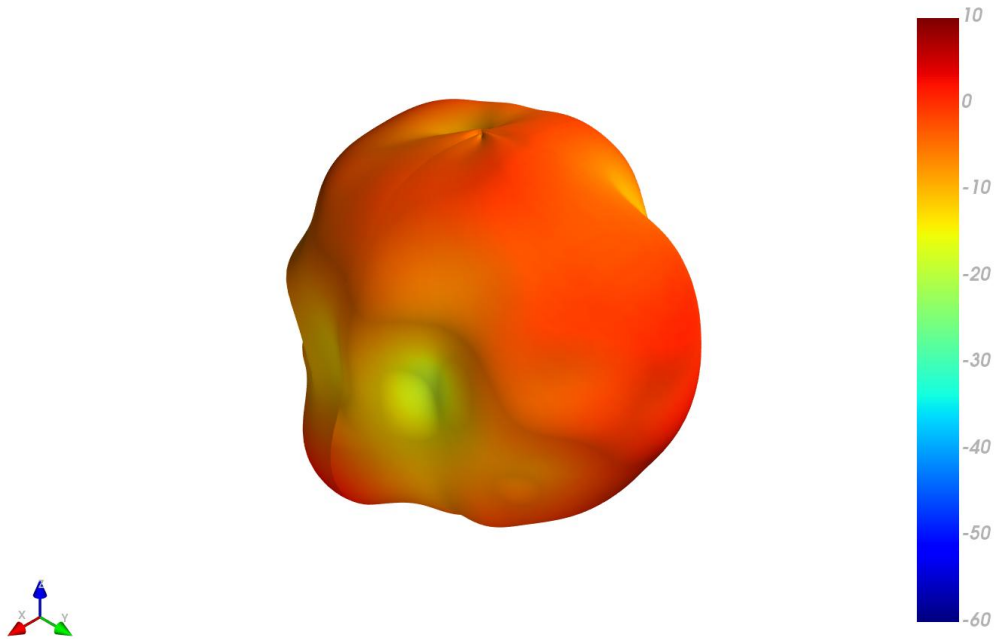
7.10 5G-4G-1 Patterns at 1995 MHz



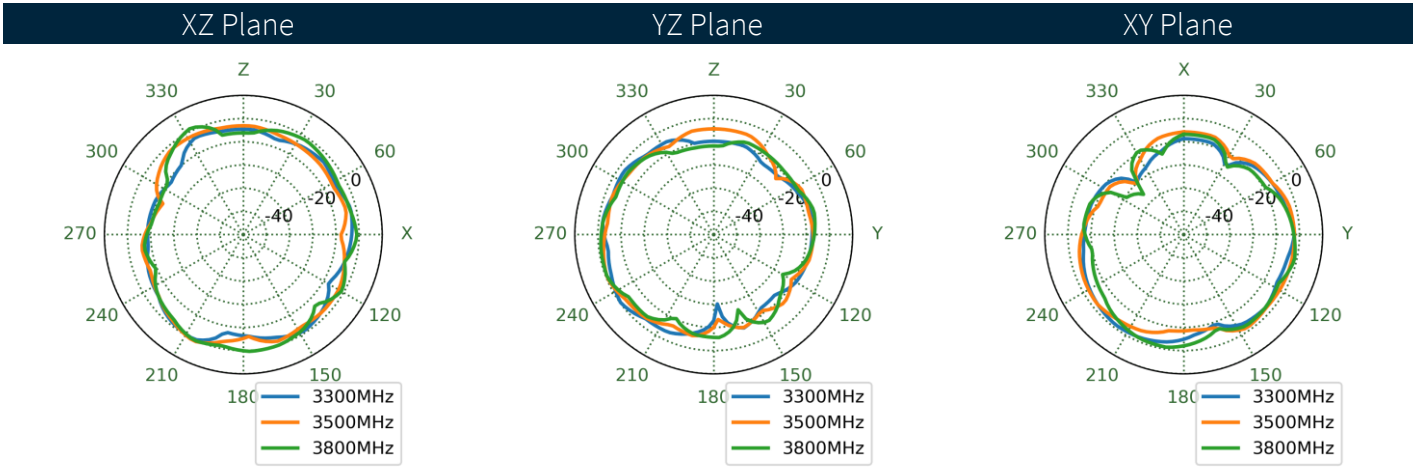
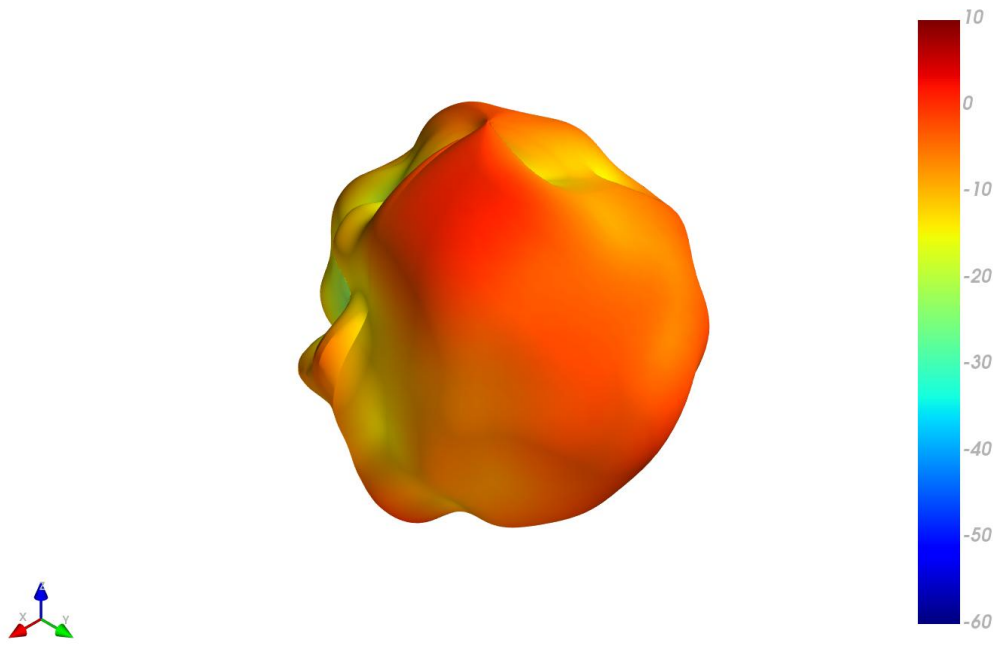
XZ Plane YZ Plane XY Plane



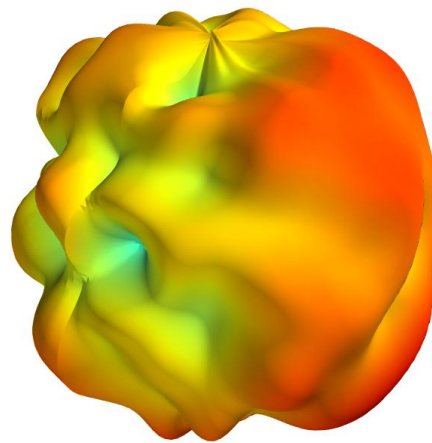
7.11 5G-4G-1 Patterns at 2570 MHz



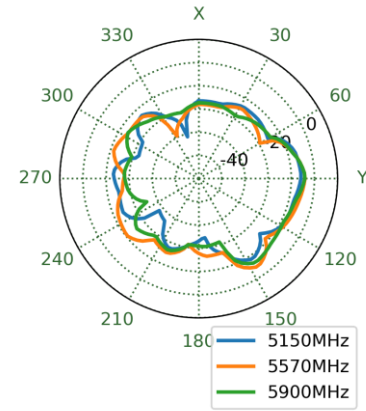
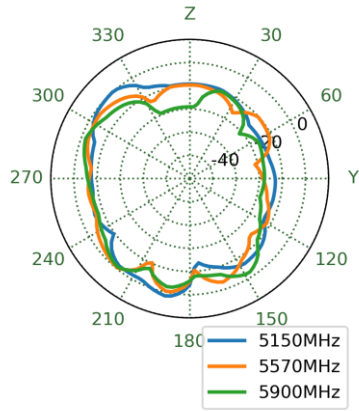
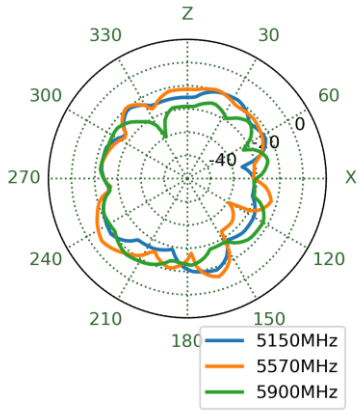
7.12 5G-4G-1 Patterns at 3500 MHz



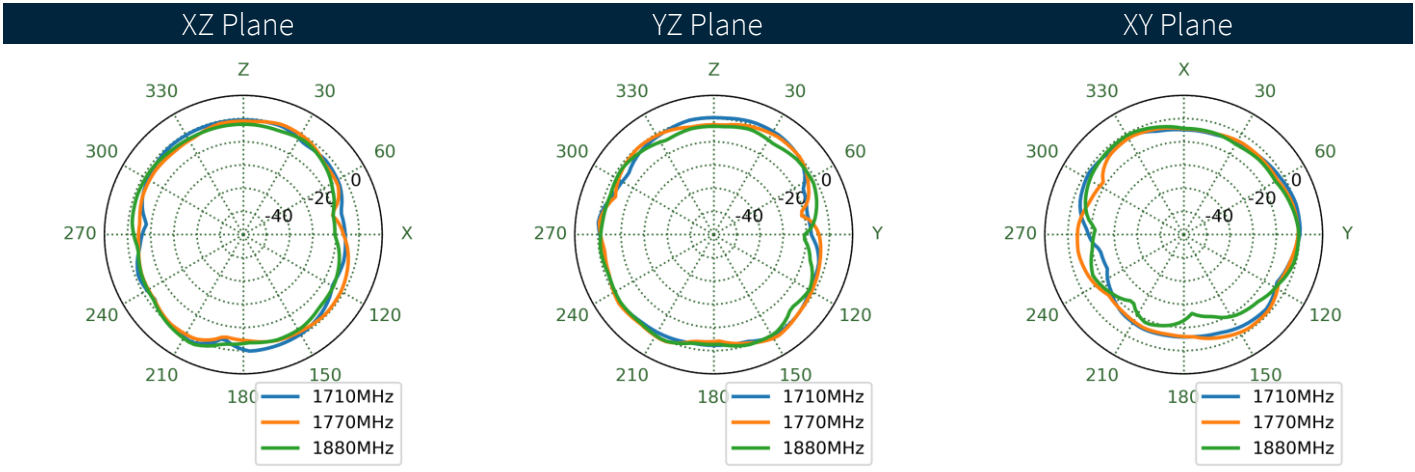
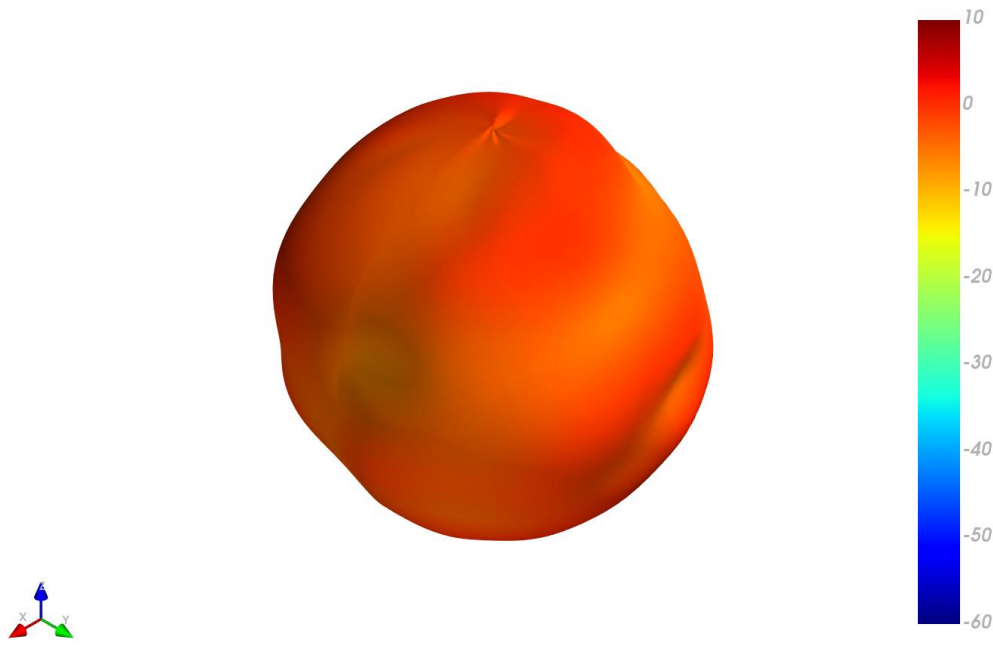
7.13 5G-4G-1 Patterns at 5570 MHz



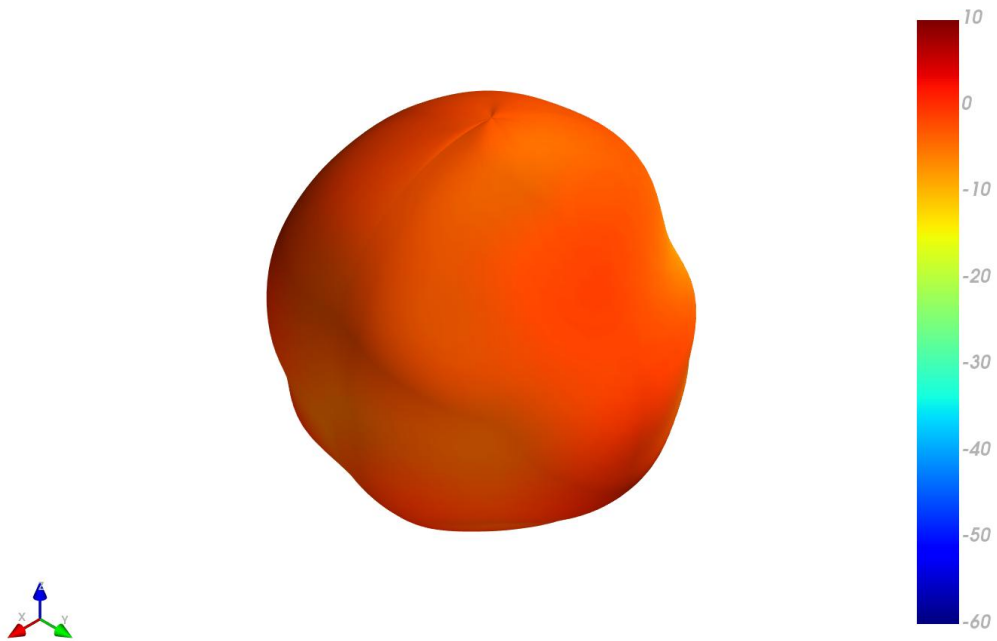
XZ Plane YZ Plane XY Plane



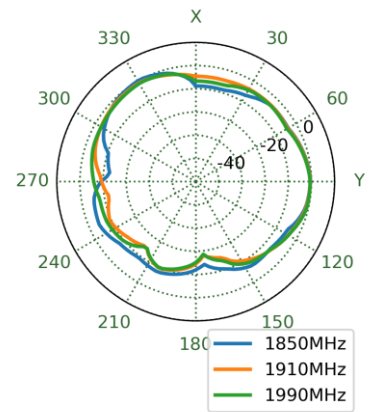
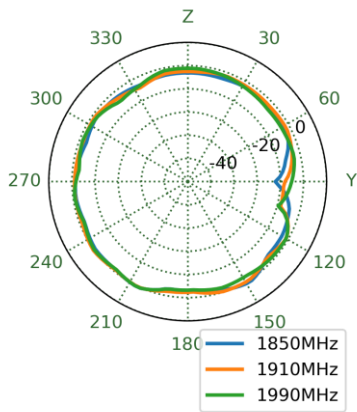
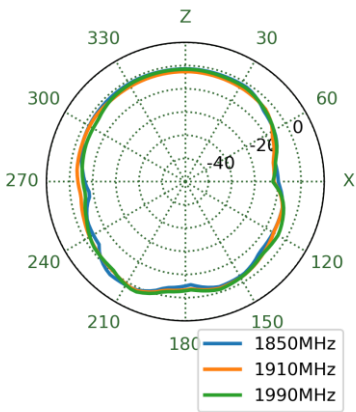
7.14 5G-4G-8 Patterns at 1770 MHz



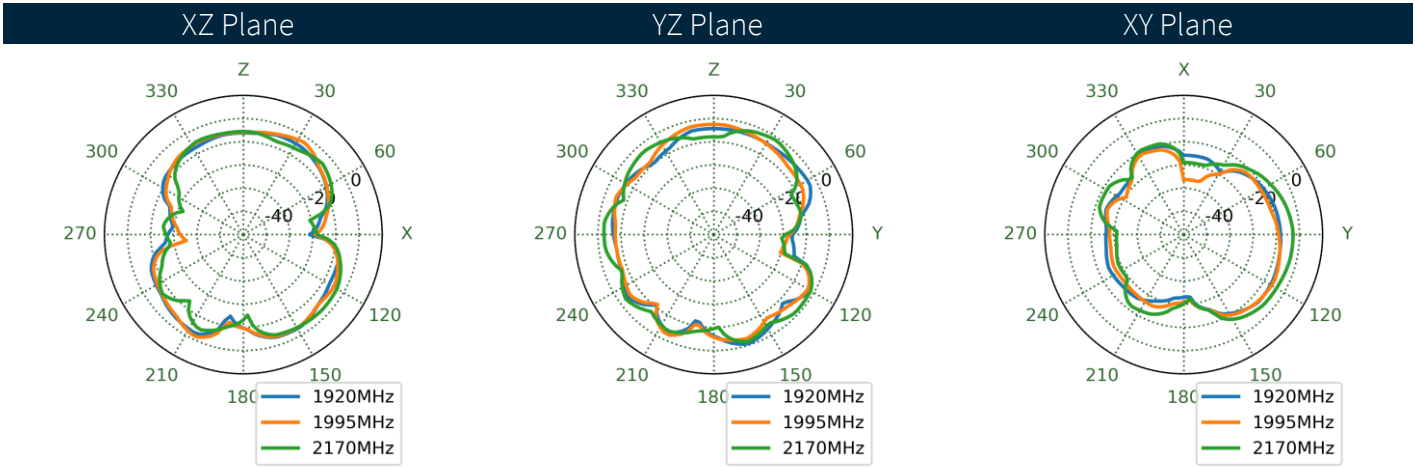
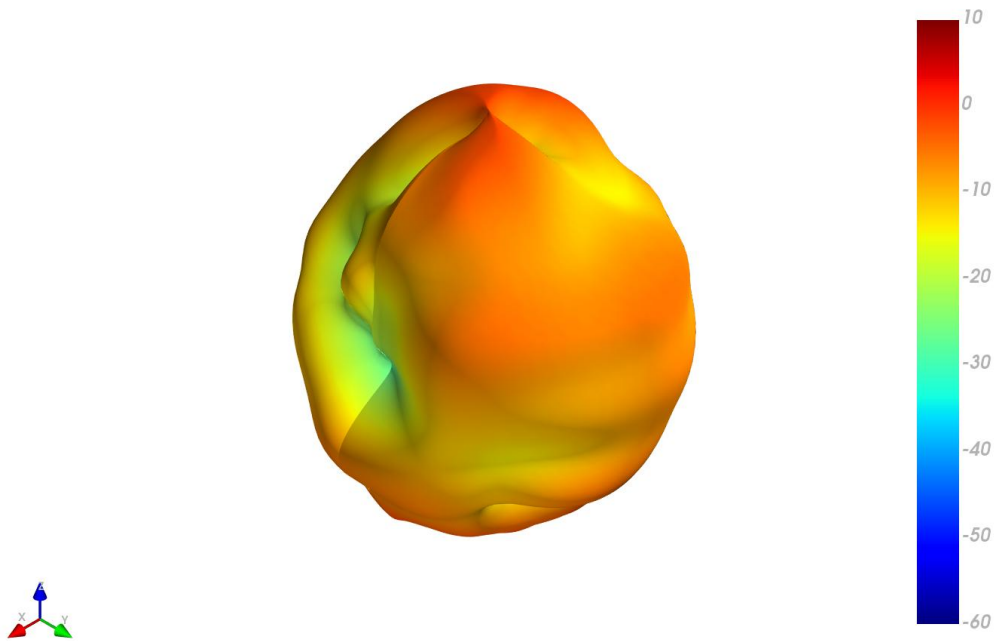
7.15 5G-4G-8 Patterns at 1910 MHz



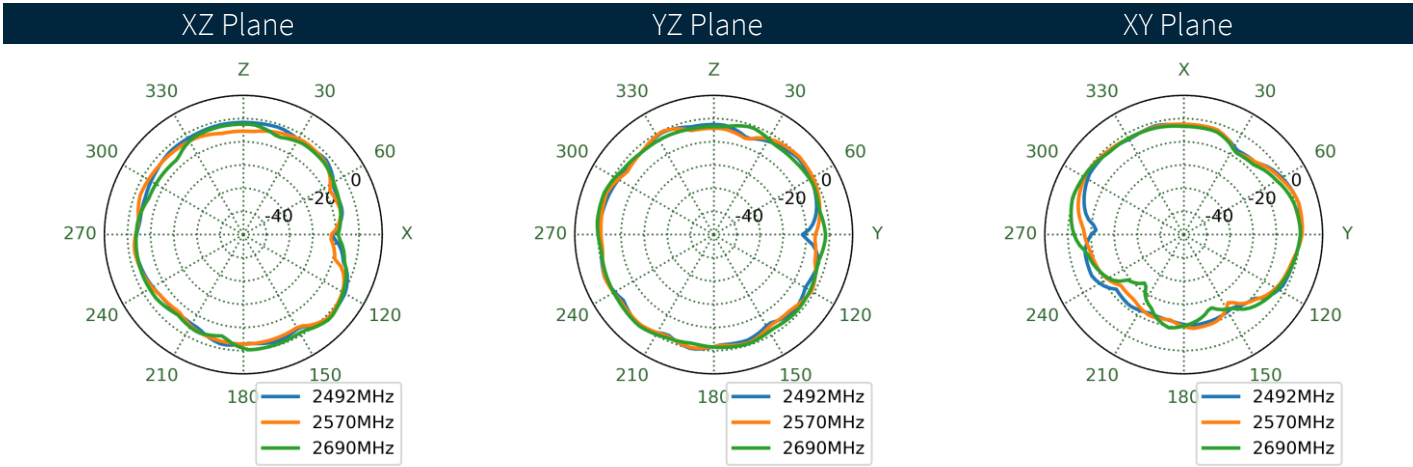
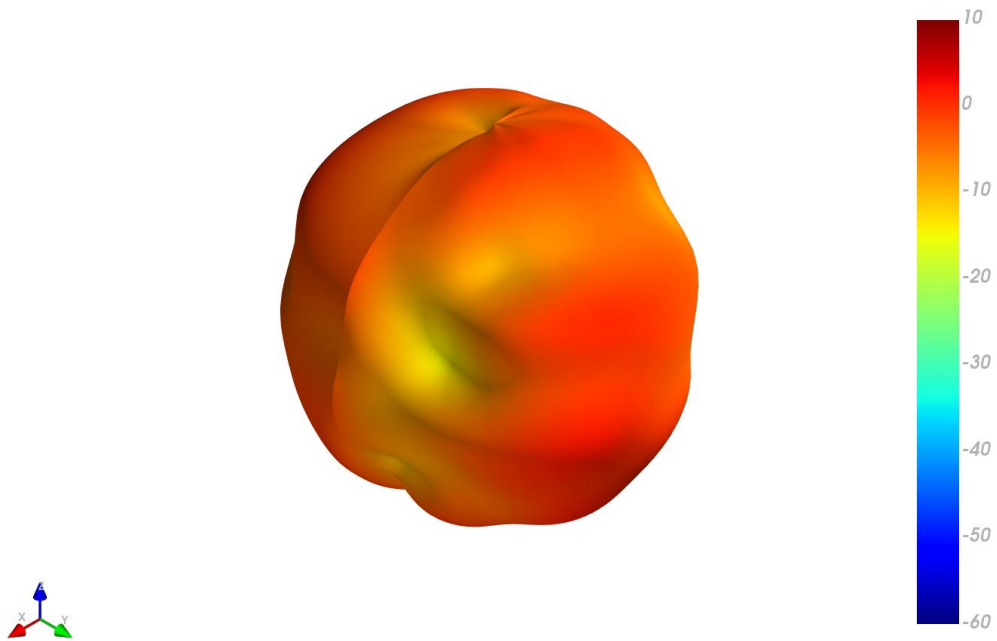
XZ Plane YZ Plane XY Plane



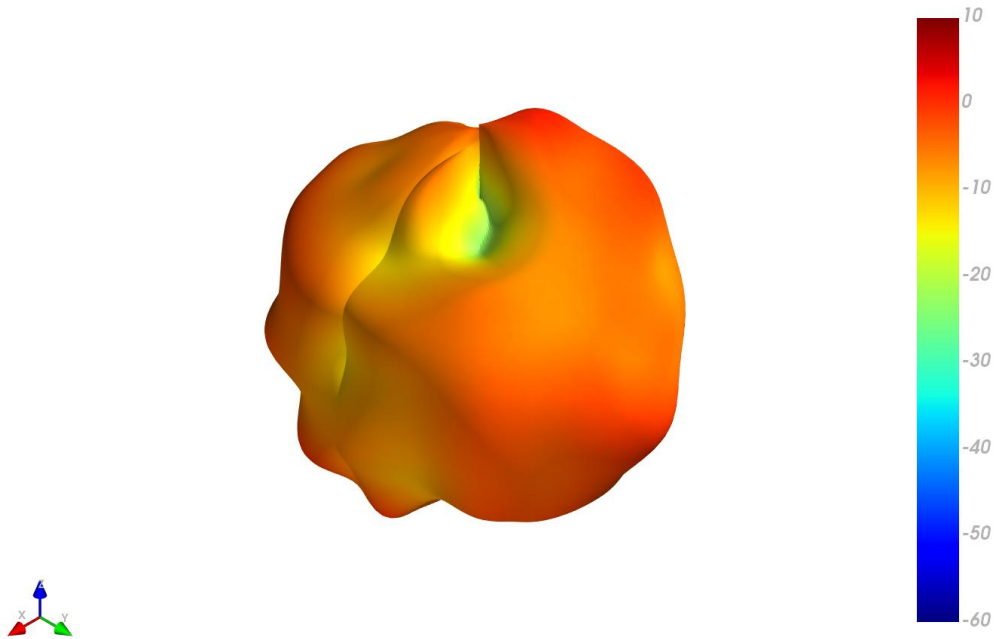
7.16 5G-4G-8 Patterns at 1995 MHz



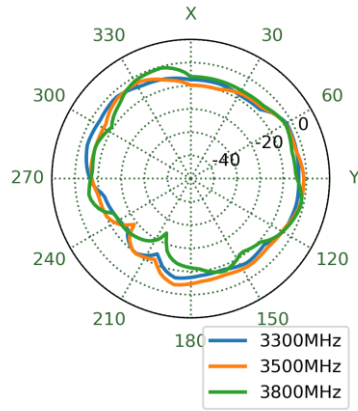
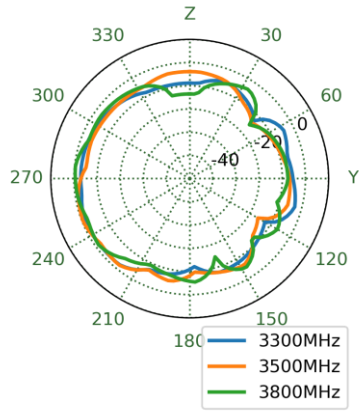
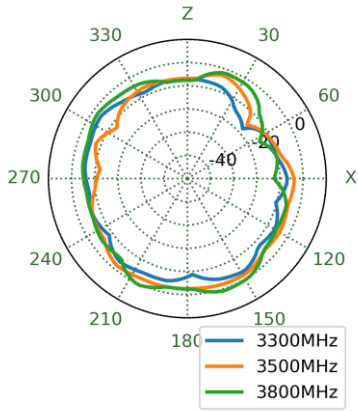
7.17 5G-4G-8 Patterns at 2570 MHz



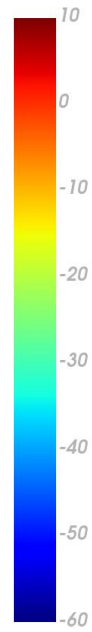
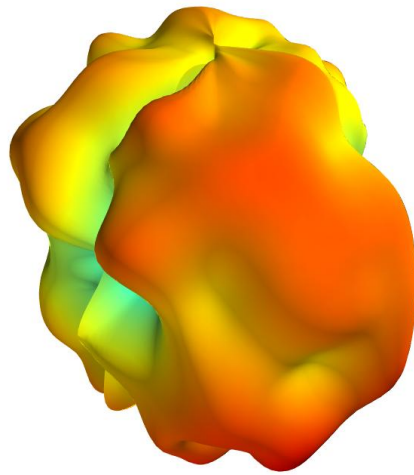
7.18 5G-4G-8 Patterns at 3500 MHz



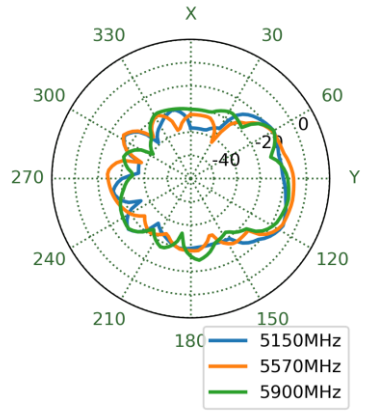
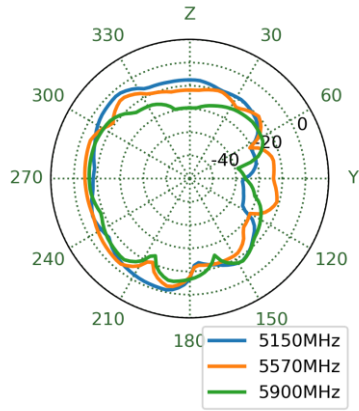
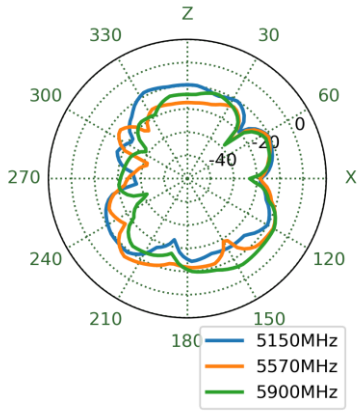
XZ Plane YZ Plane XY Plane



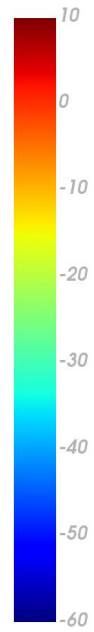
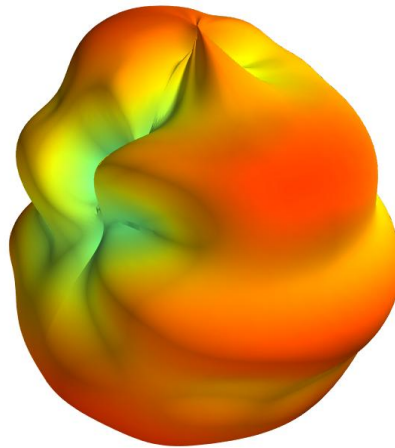
7.19 5G-4G-8 Patterns at 5570 MHz



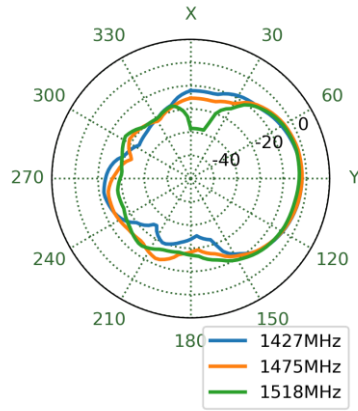
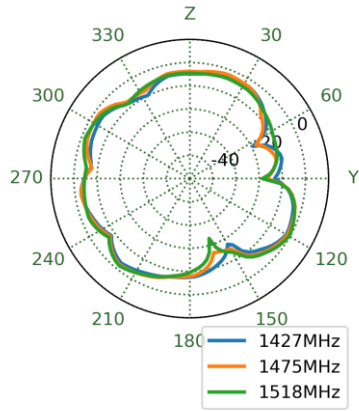
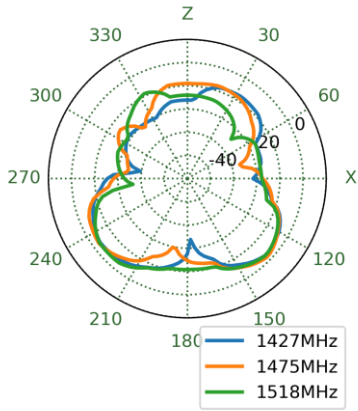
XZ Plane YZ Plane XY Plane



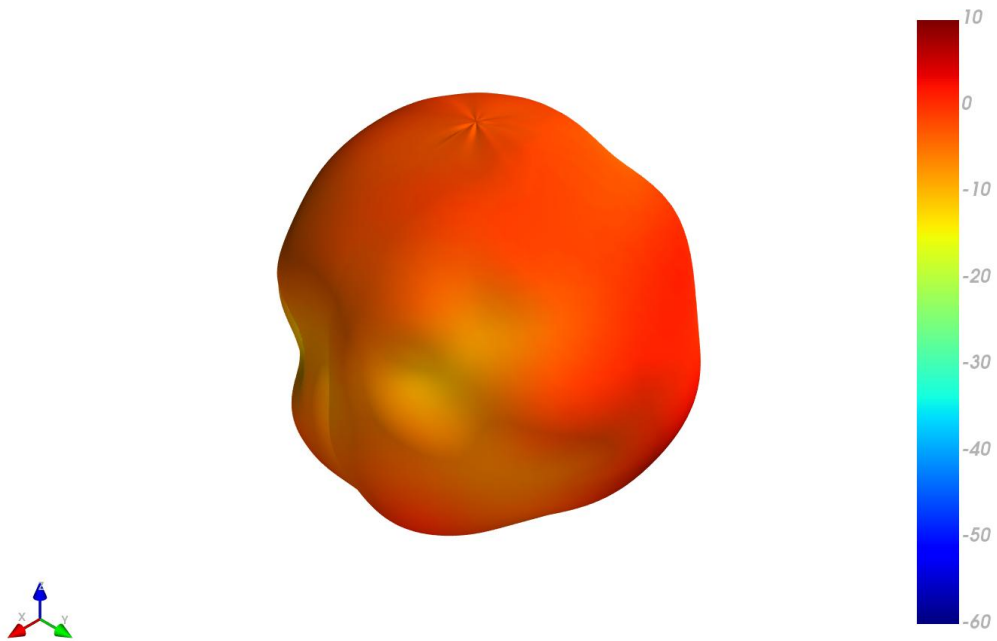
7.20 5G-4G-2 Patterns at 1475 MHz



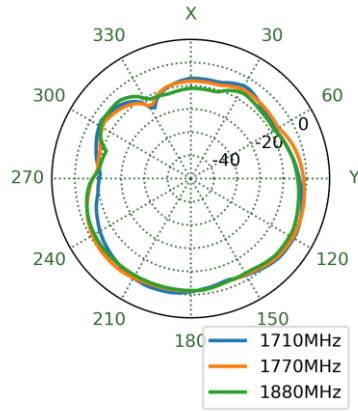
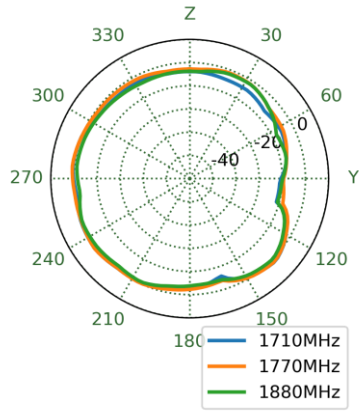
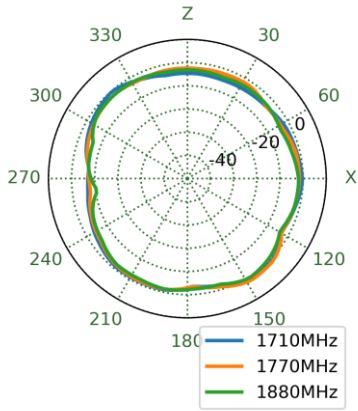
XZ Plane YZ Plane XY Plane



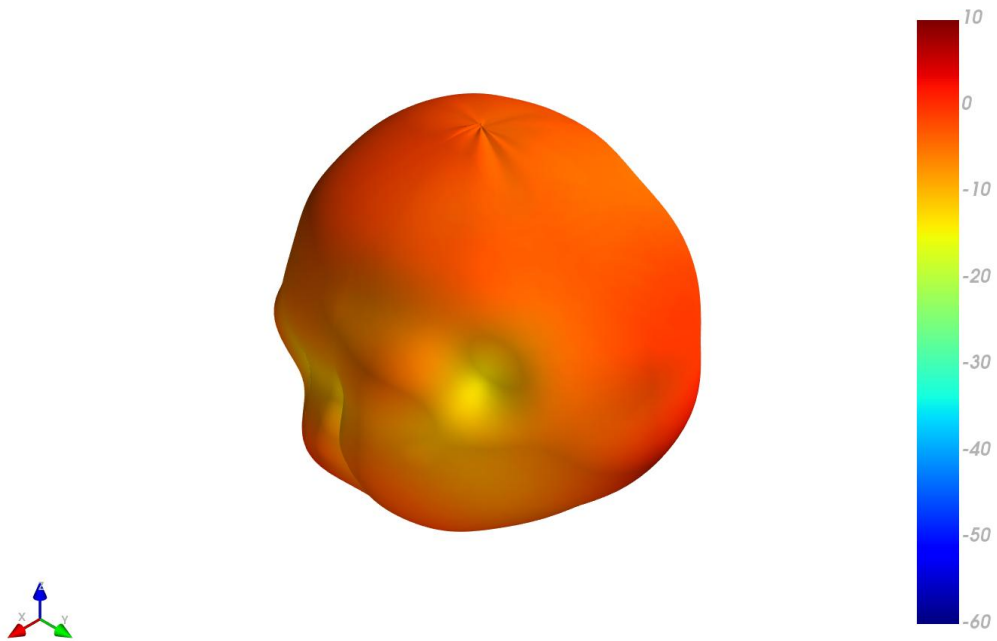
7.21 5G-4G-2 Patterns at 1770 MHz



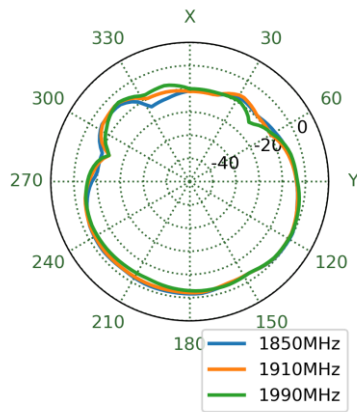
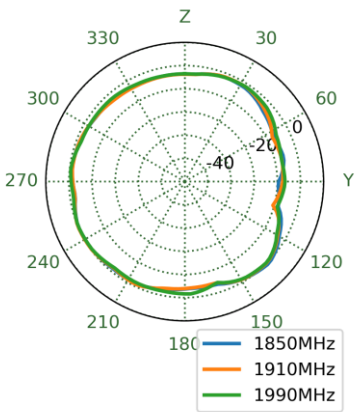
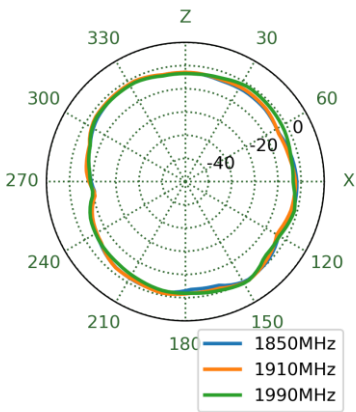
XZ Plane YZ Plane XY Plane



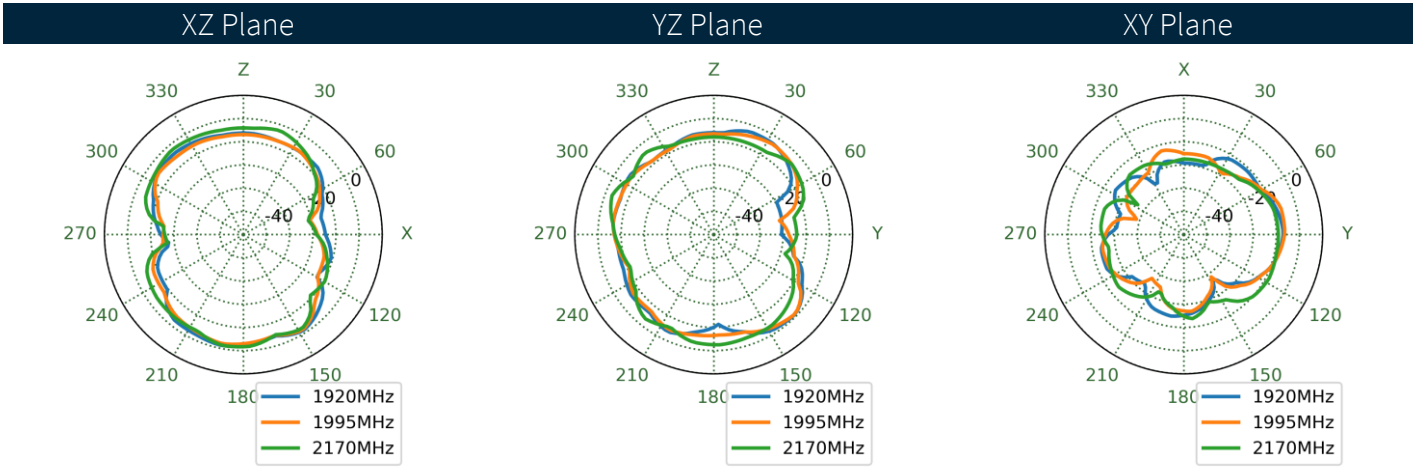
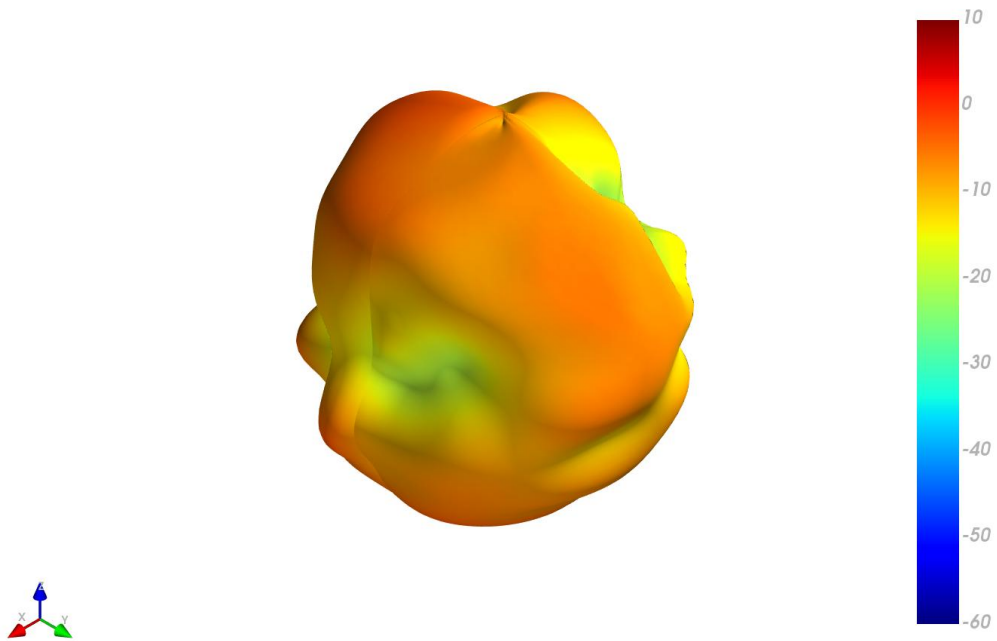
7.22 5G-4G-2 Patterns at 1910 MHz



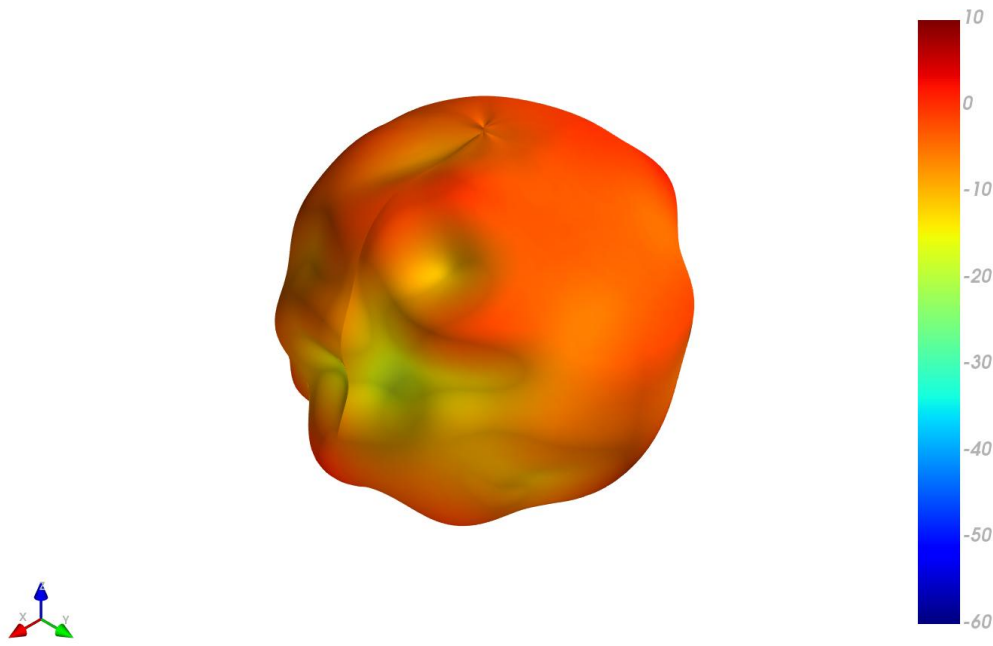
XZ Plane YZ Plane XY Plane



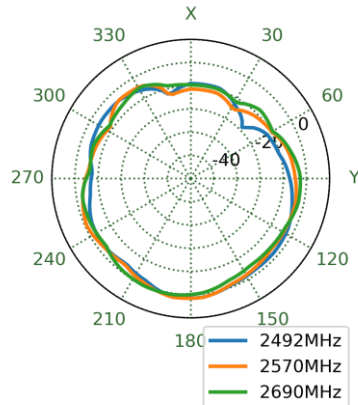
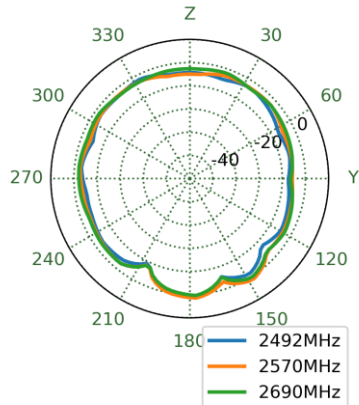
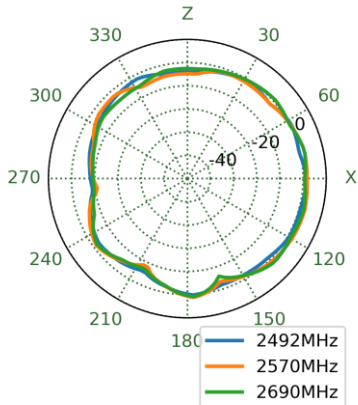
7.23 5G-4G-2 Patterns at 1995 MHz



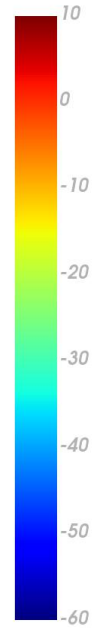
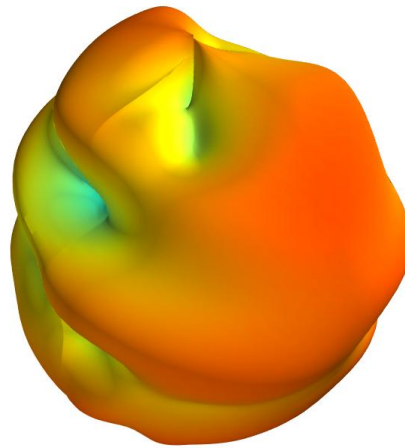
7.24 5G-4G-2 Patterns at 2570 MHz



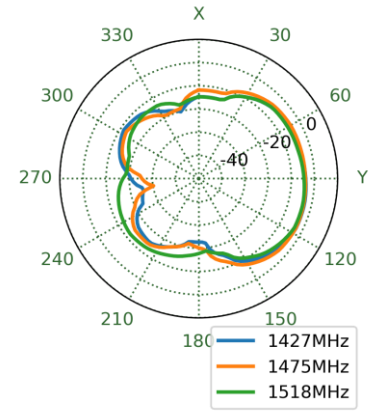
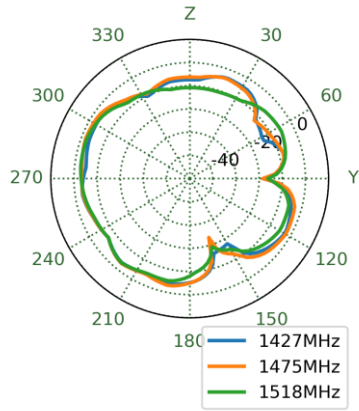
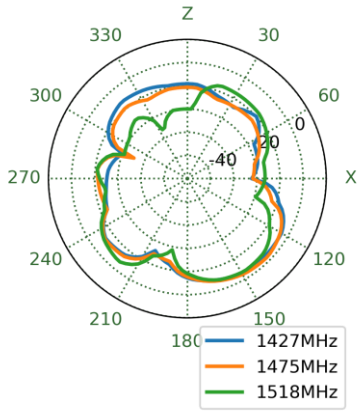
XZ Plane YZ Plane XY Plane



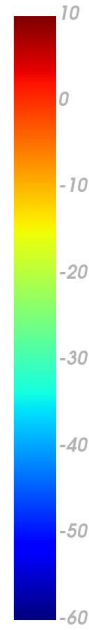
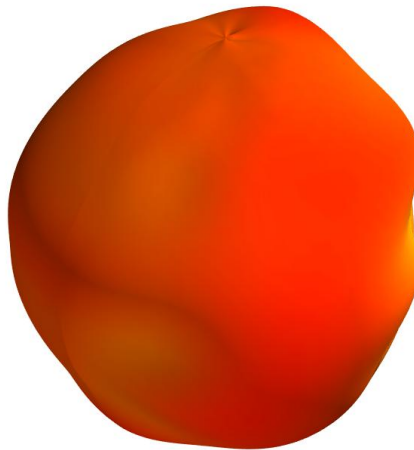
7.25 5G-4G-7 Patterns at 1475 MHz



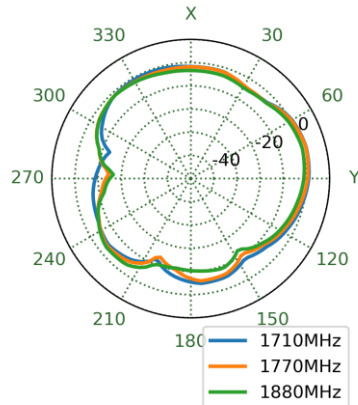
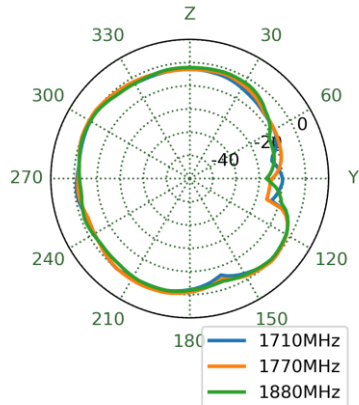
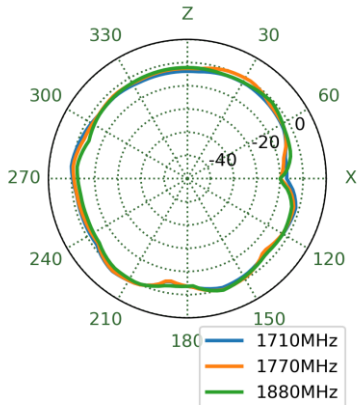
XZ Plane YZ Plane XY Plane



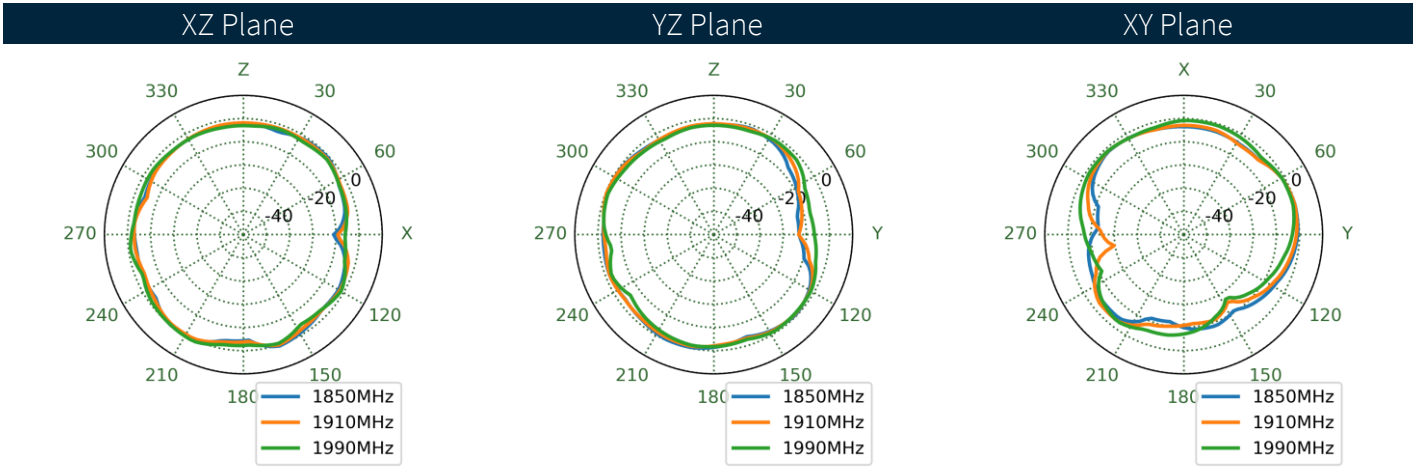
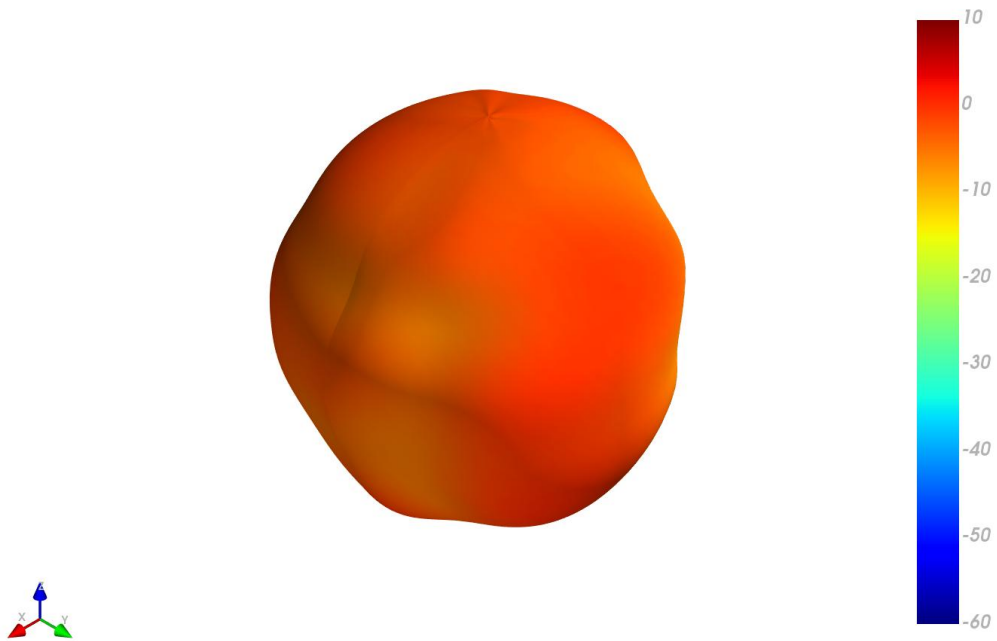
7.26 5G-4G-7 Patterns at 1770 MHz



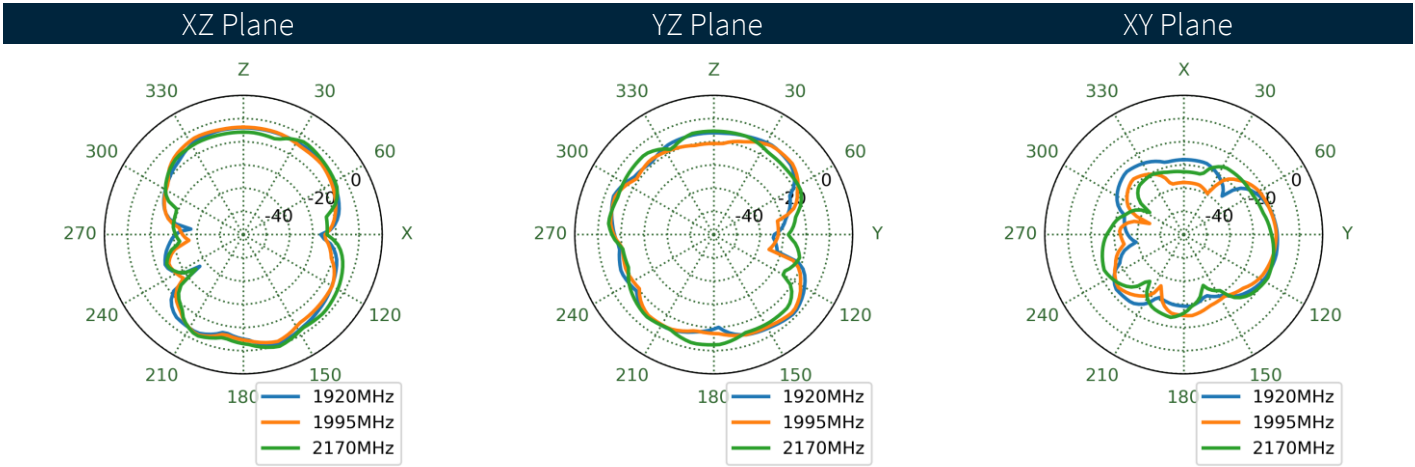
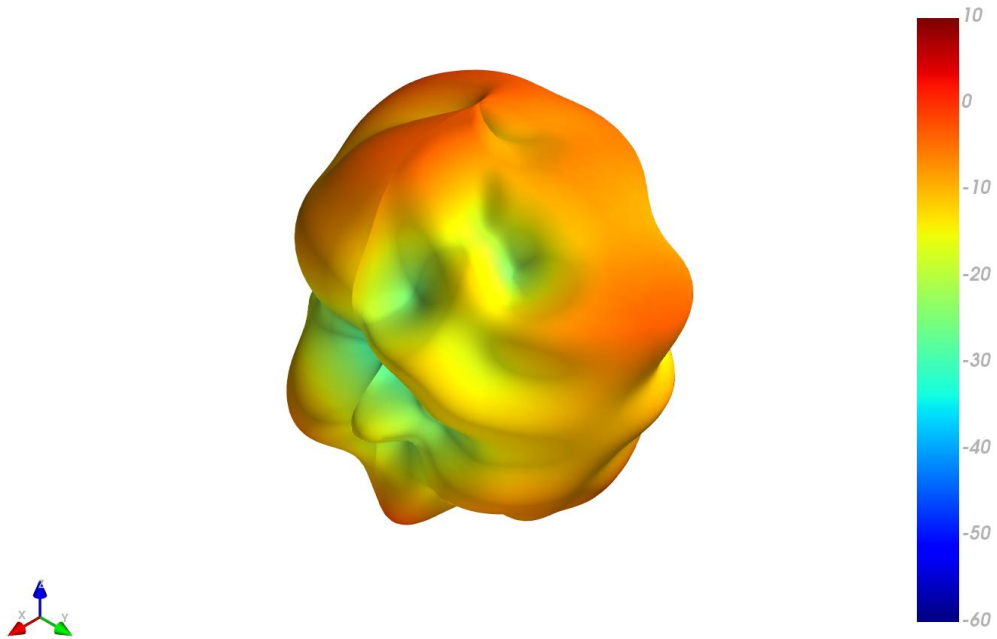
XZ Plane YZ Plane XY Plane



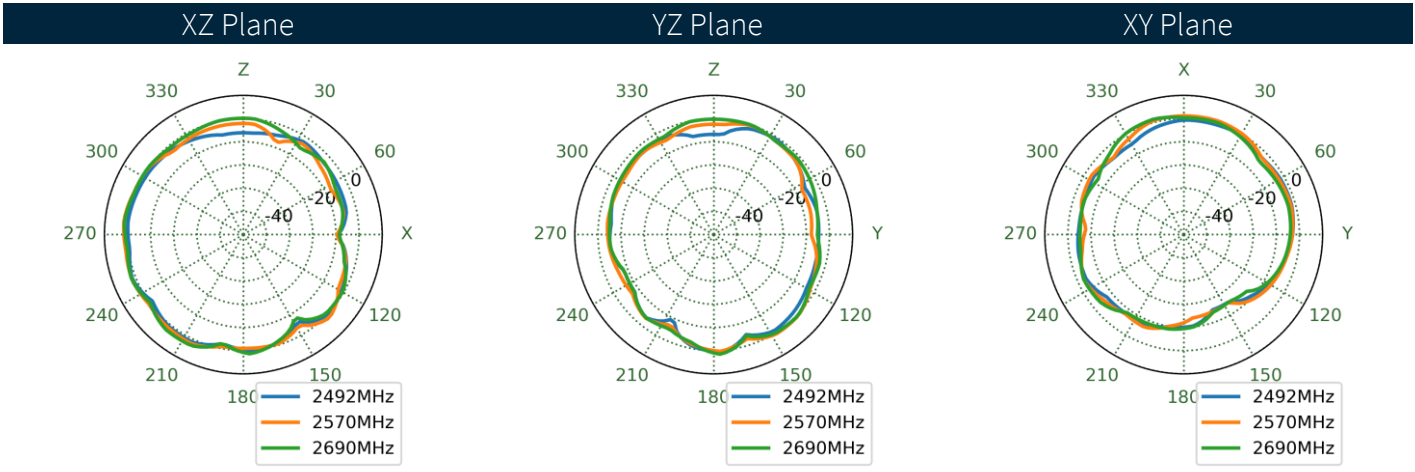
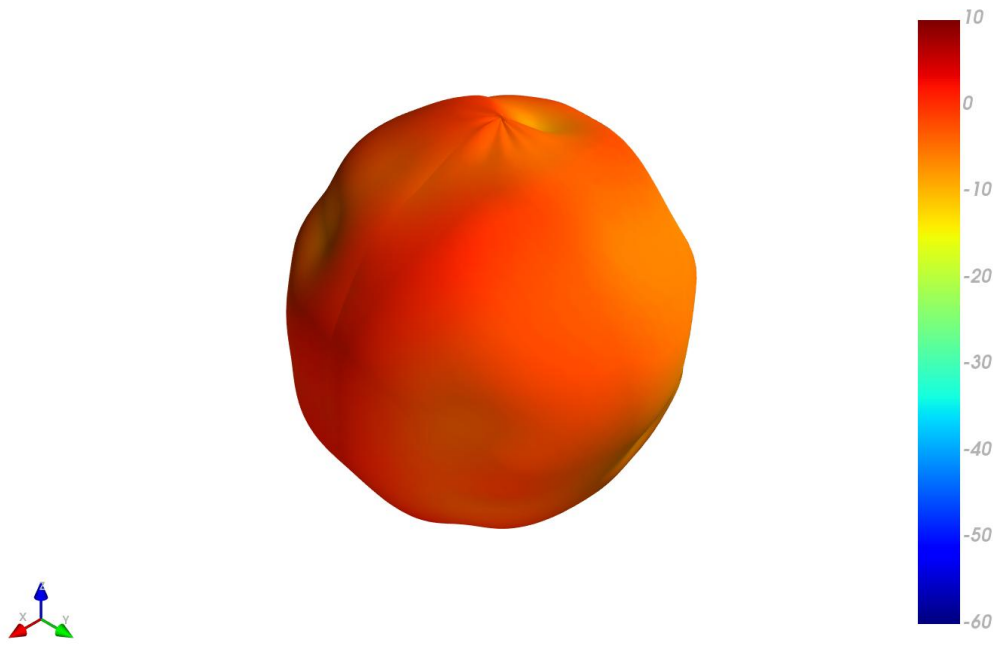
7.27 5G-4G-7 Patterns at 1910 MHz



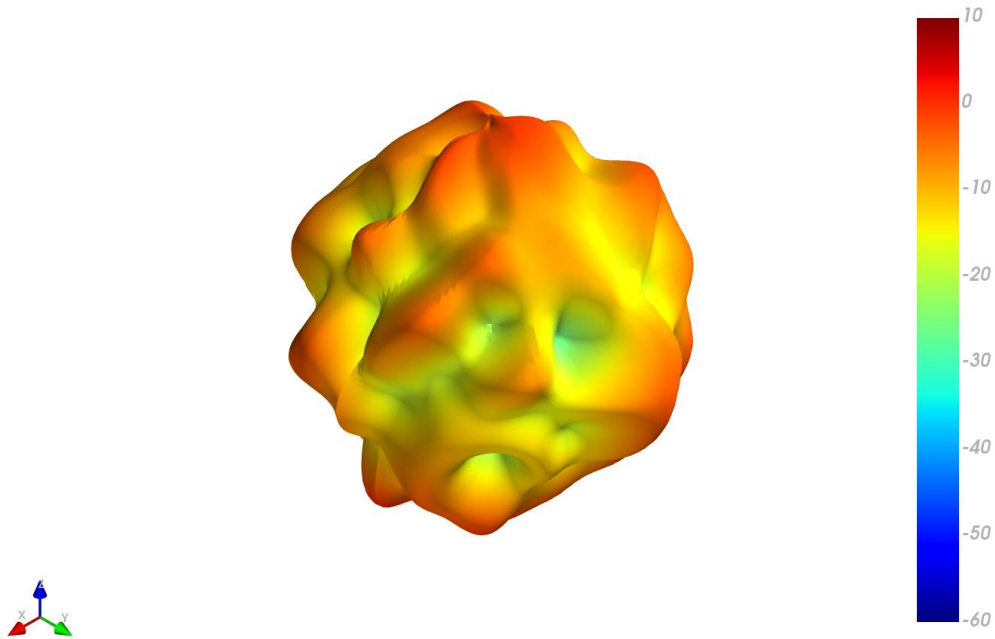
7.28 5G-4G-2 Patterns at 1995 MHz



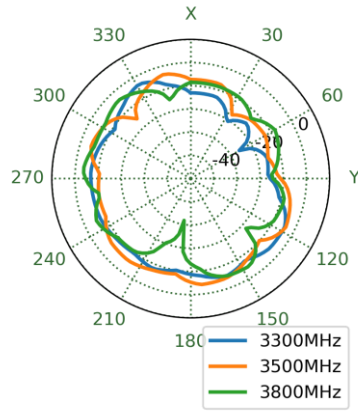
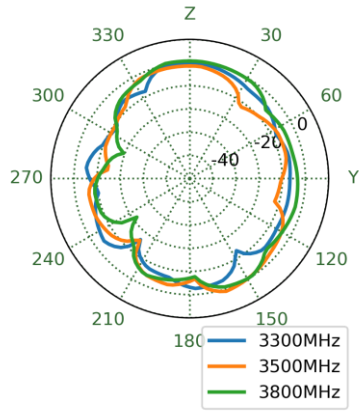
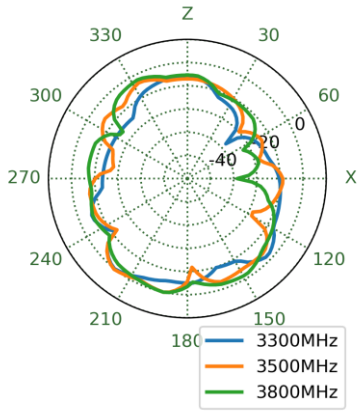
7.29 5G-4G-7 Patterns at 2570 MHz



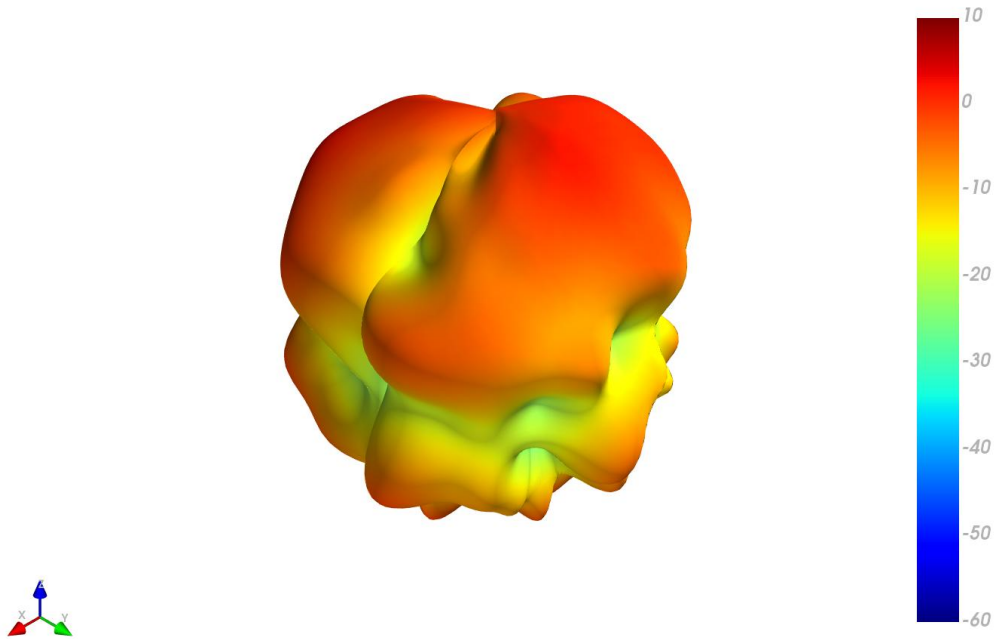
7.30 5G-4G-3 Patterns at 3500 MHz



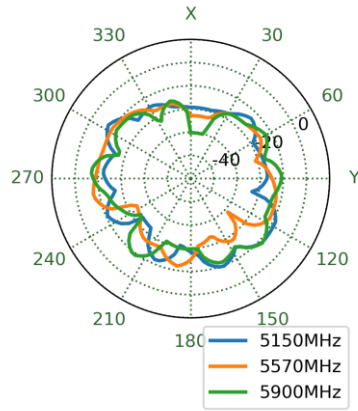
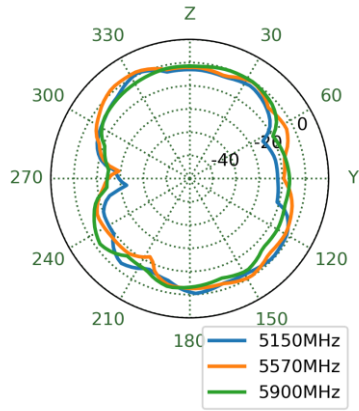
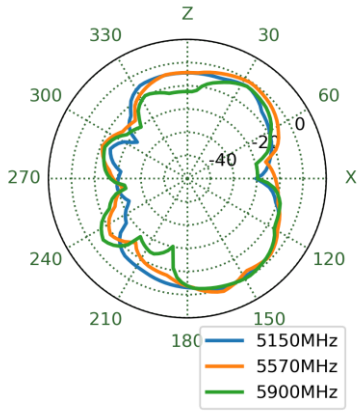
XZ Plane YZ Plane XY Plane



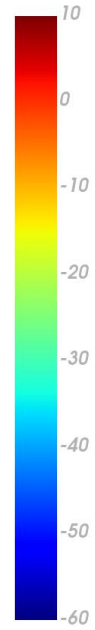
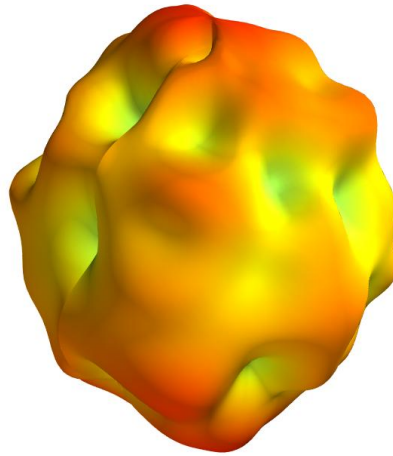
7.31 5G-4G-3 Patterns at 5570 MHz



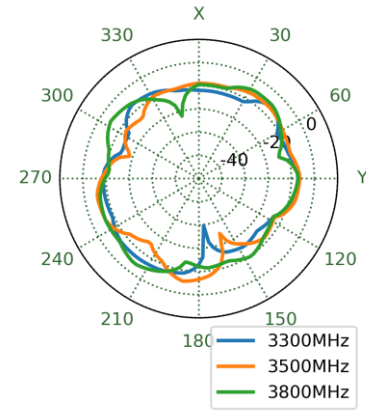
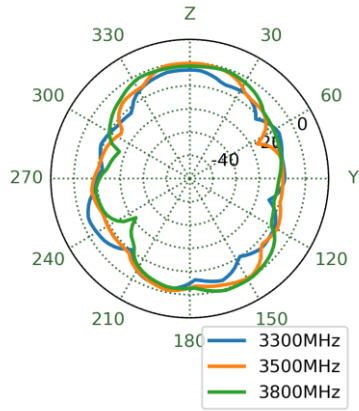
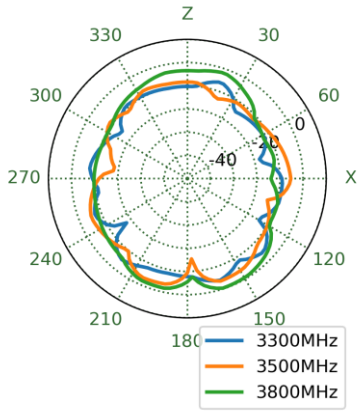
XZ Plane YZ Plane XY Plane



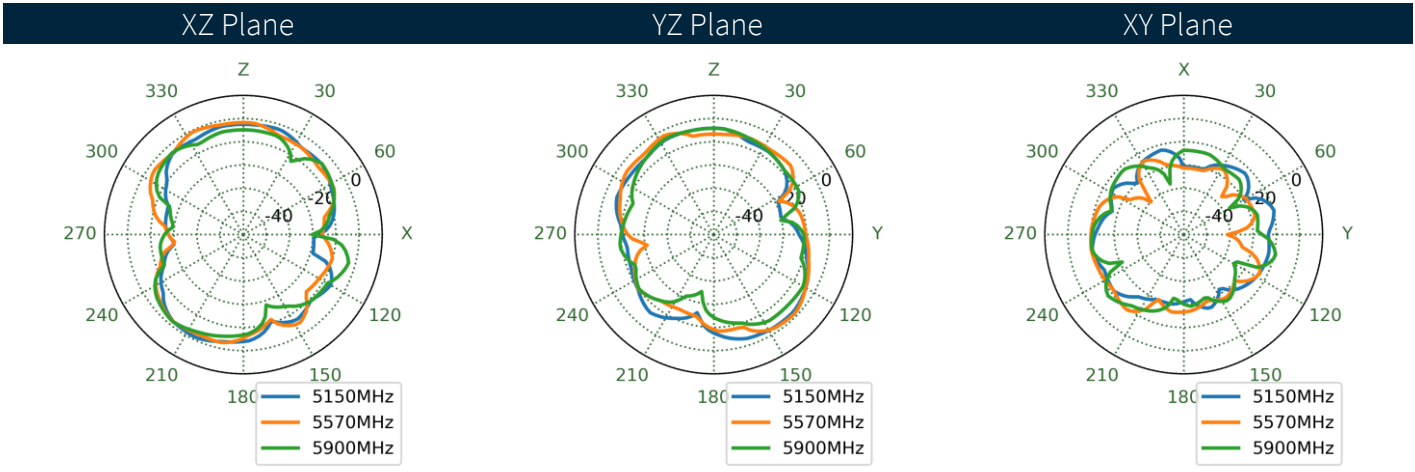
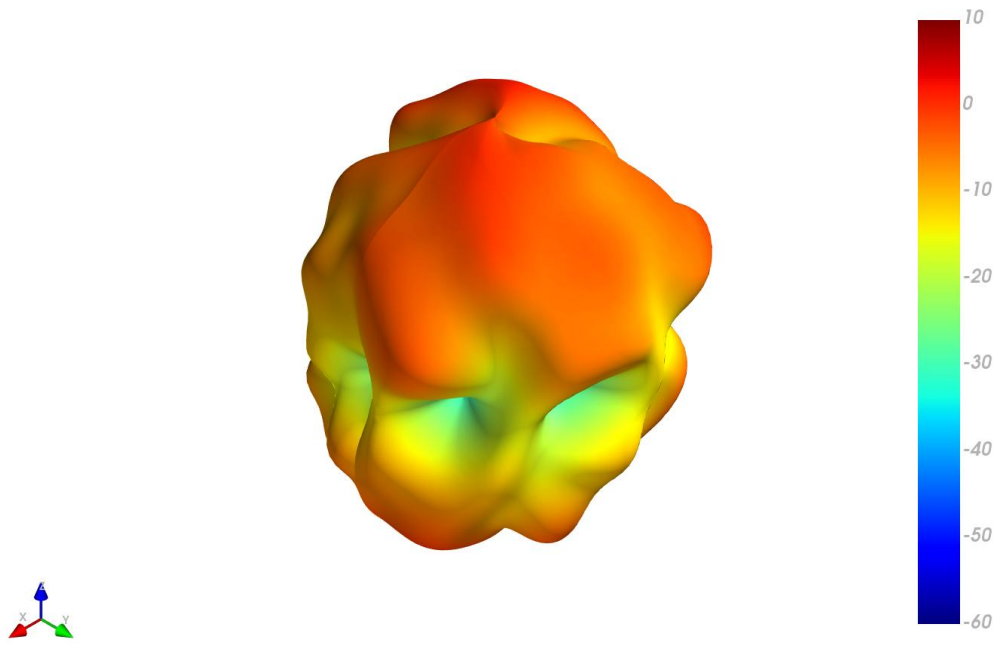
7.32 5G-4G-6 Patterns at 3500 MHz



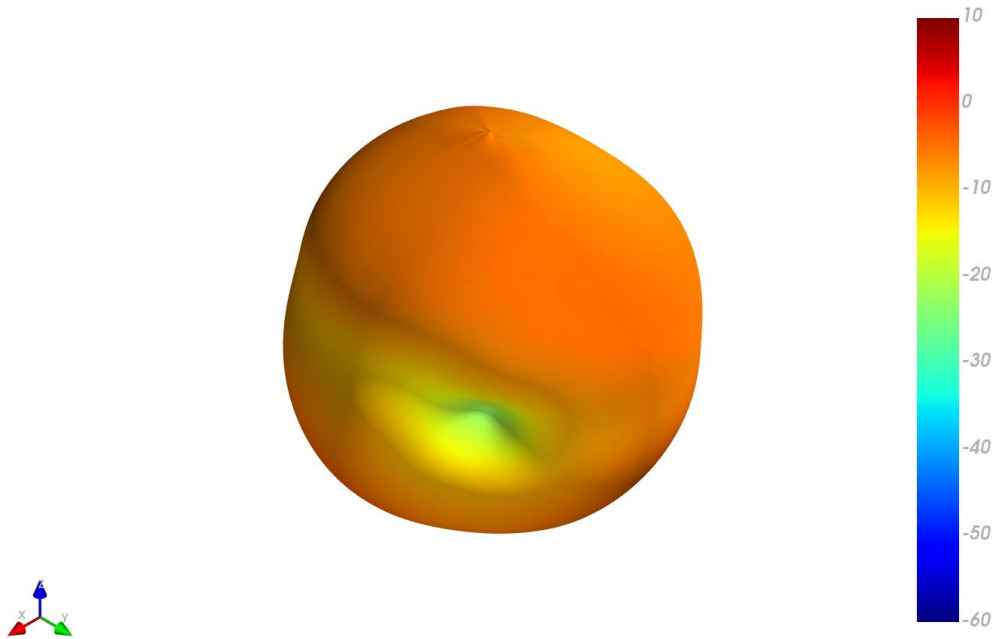
XZ Plane YZ Plane XY Plane



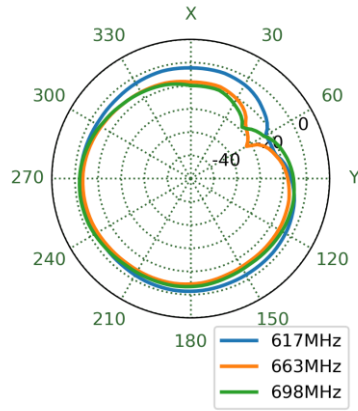
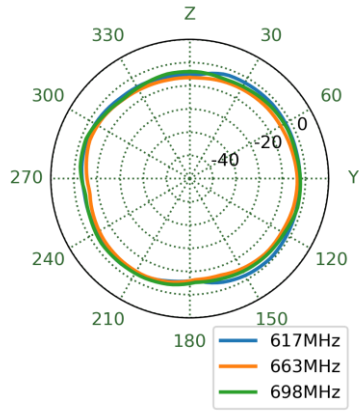
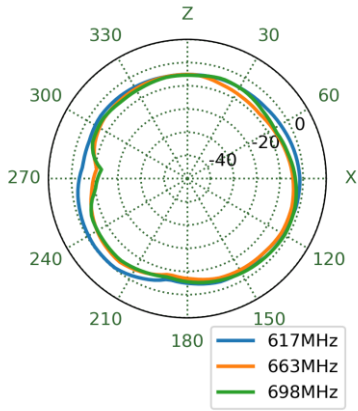
7.33 5G-4G-6 Patterns at 5570 MHz



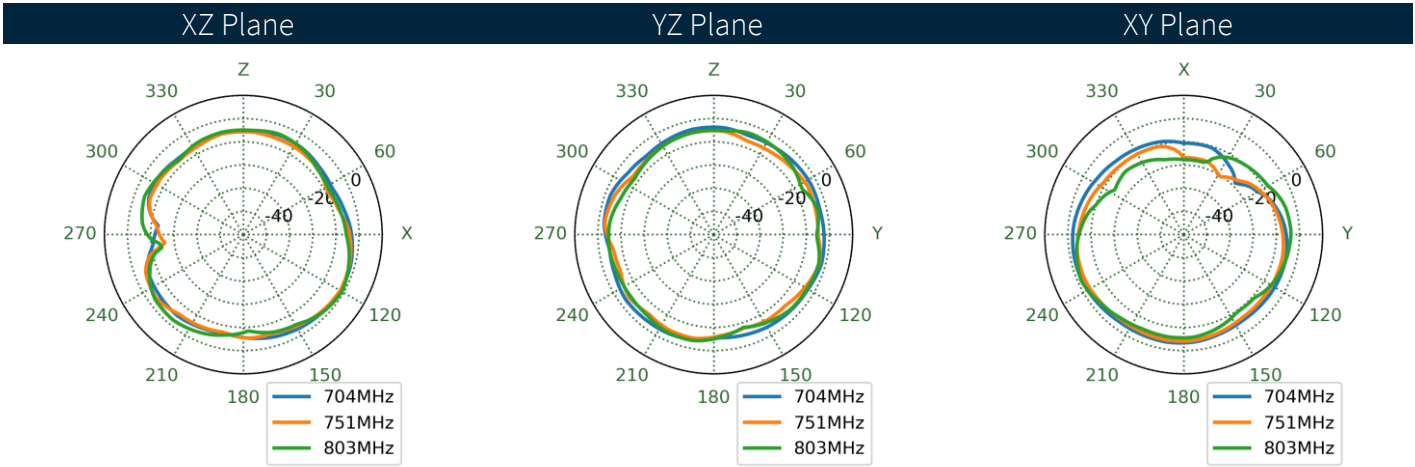
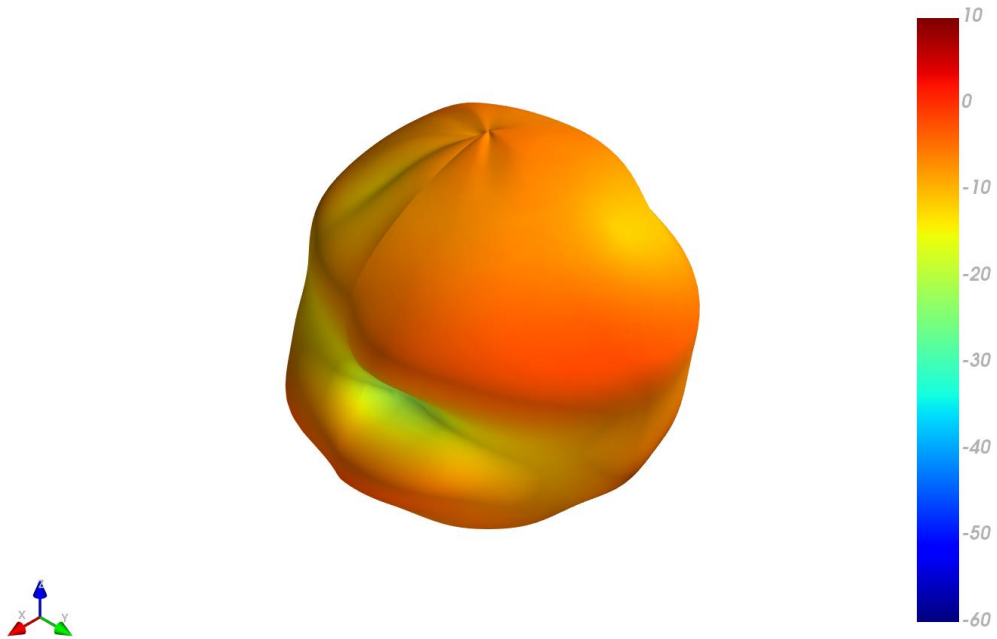
7.34 5G-4G-4 Patterns at 663 MHz



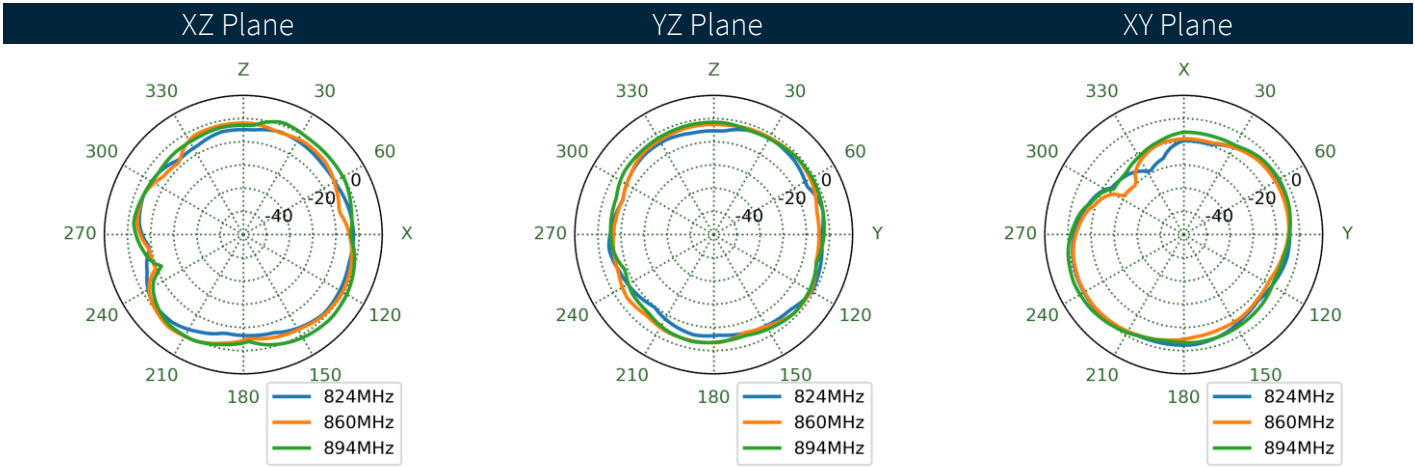
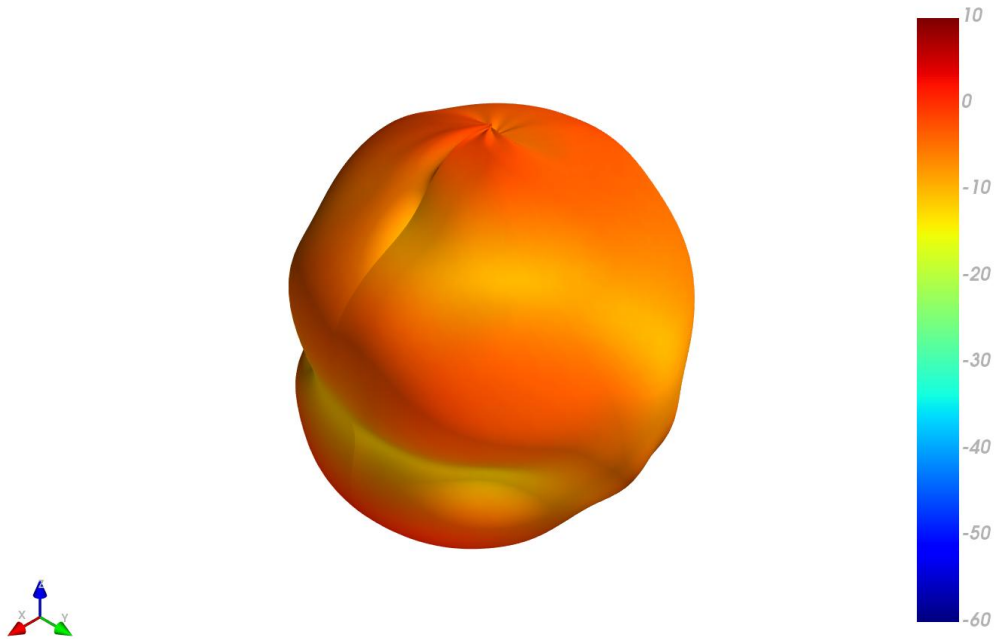
XZ Plane YZ Plane XY Plane



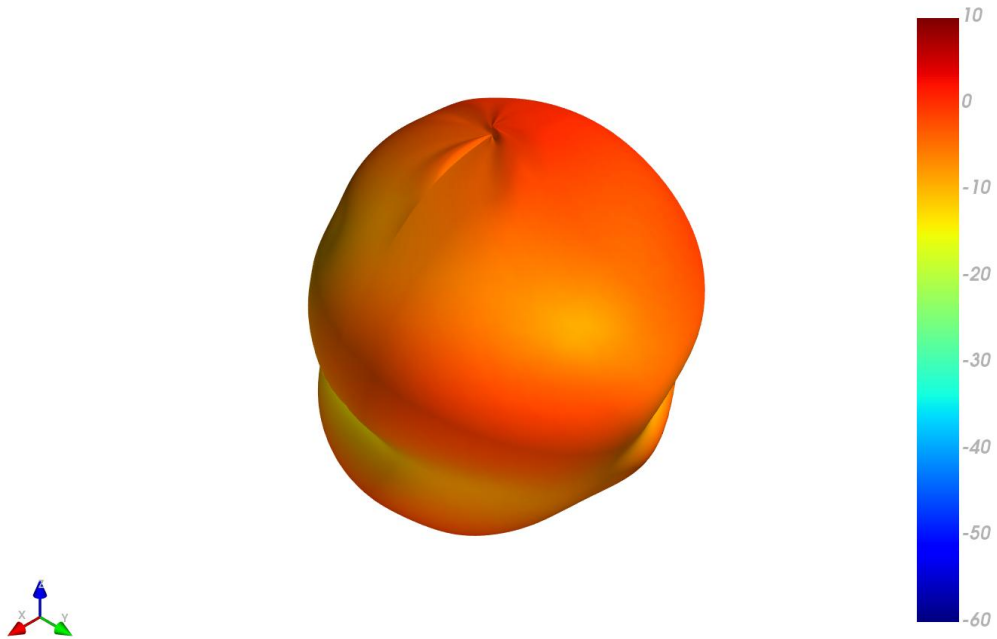
7.35 5G-4G-4 Patterns at 751 MHz



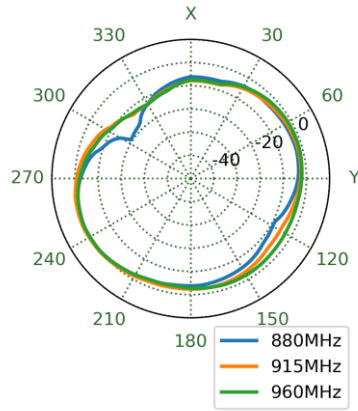
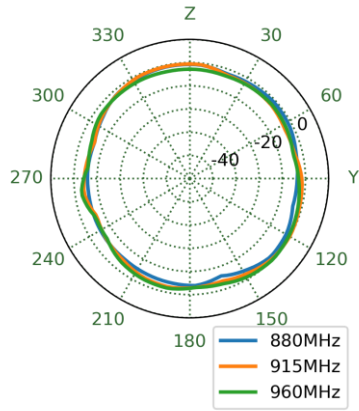
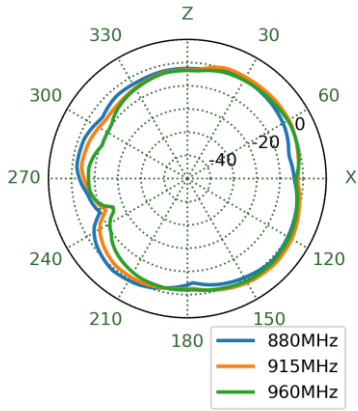
7.36 5G-4G-4 Patterns at 860 MHz



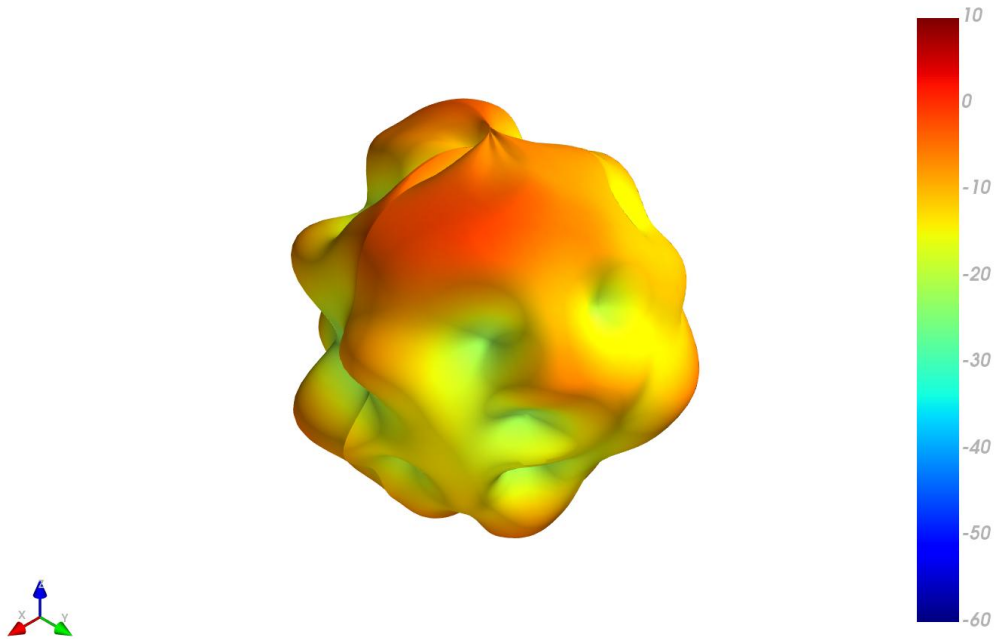
7.37 5G-4G-4 Patterns at 915 MHz



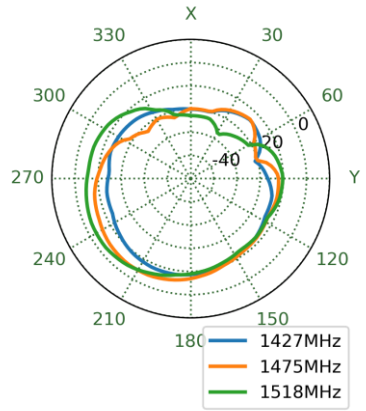
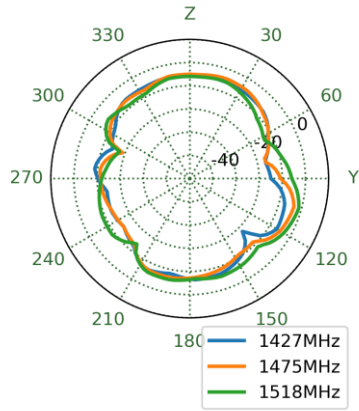
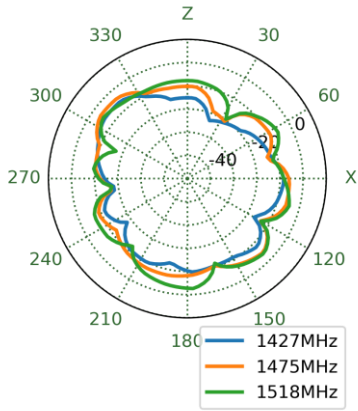
XZ Plane YZ Plane XY Plane



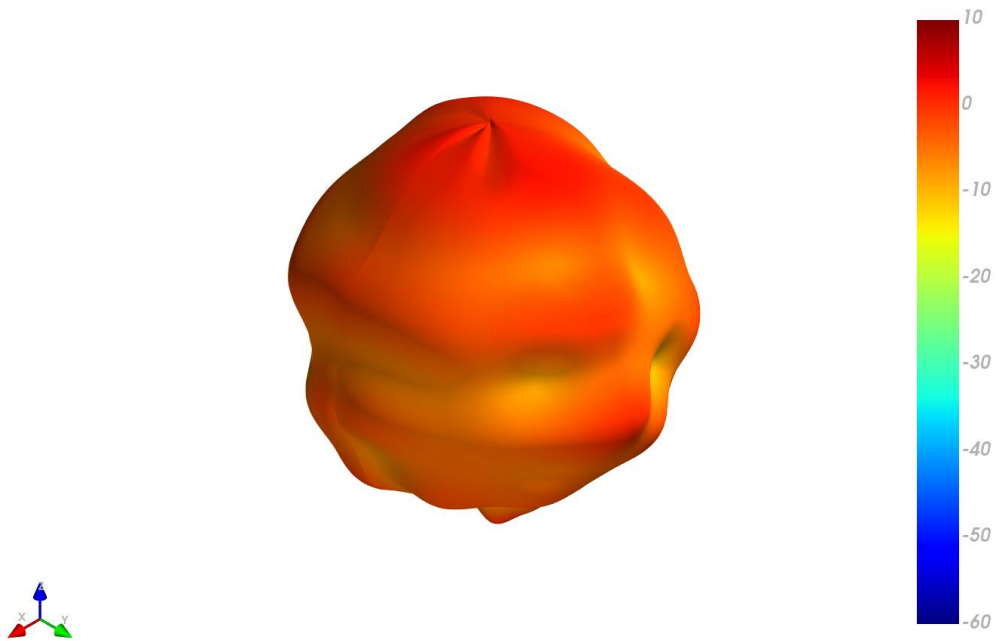
7.38 5G-4G-4 Patterns at 1475 MHz



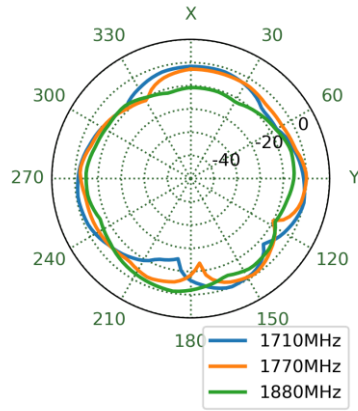
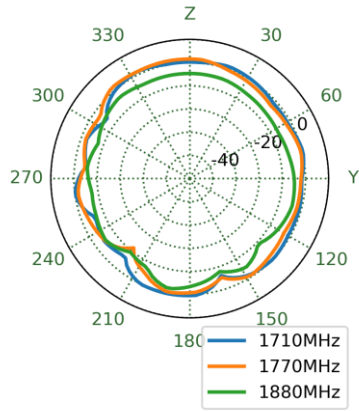
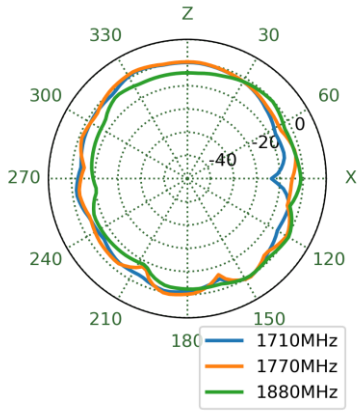
XZ Plane YZ Plane XY Plane



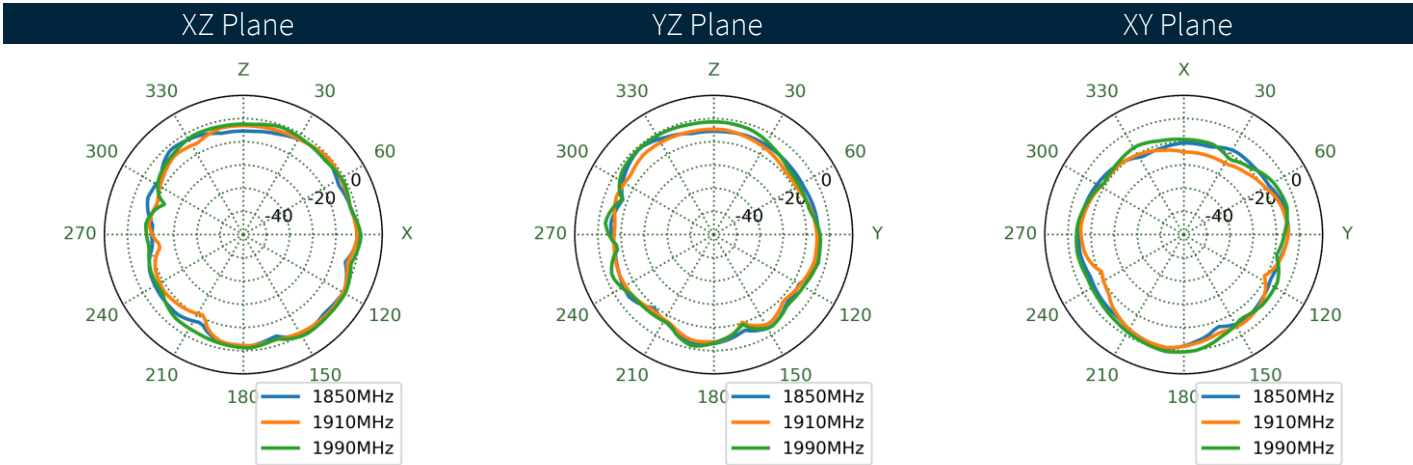
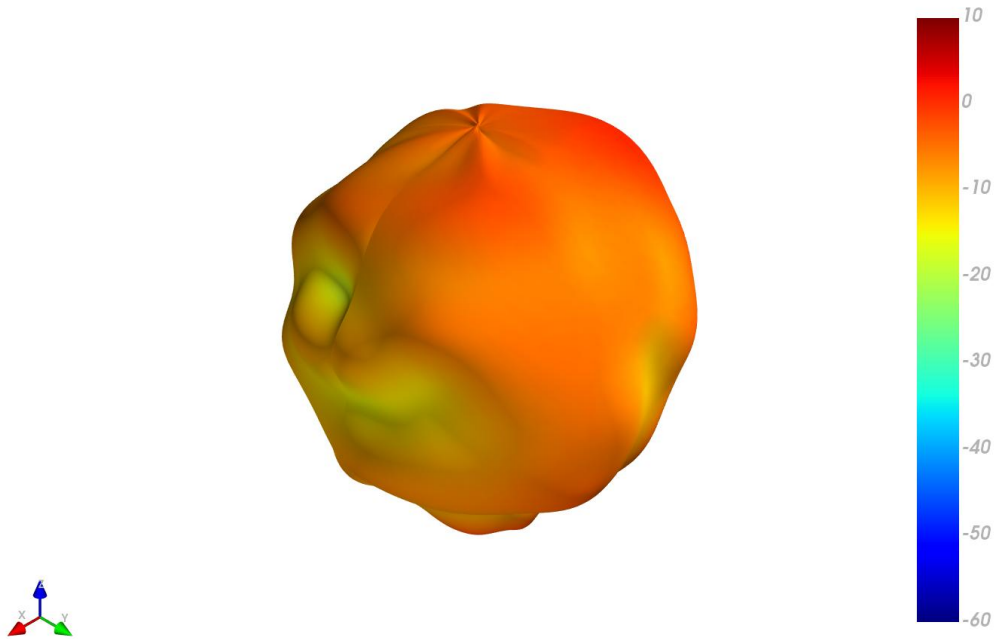
7.39 5G-4G-4 Patterns at 1770 MHz



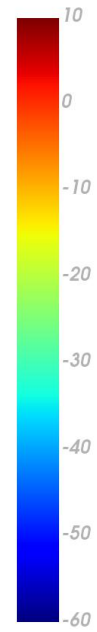
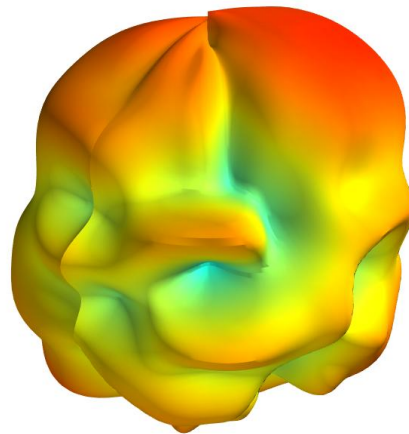
XZ Plane YZ Plane XY Plane



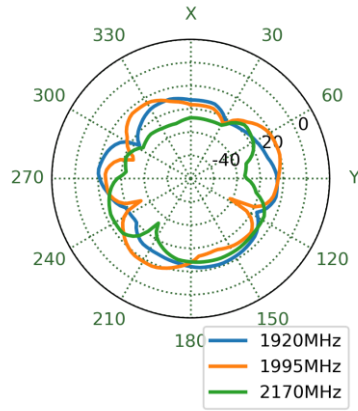
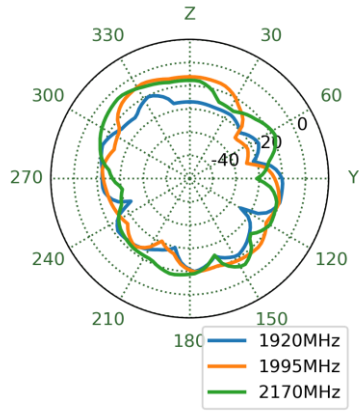
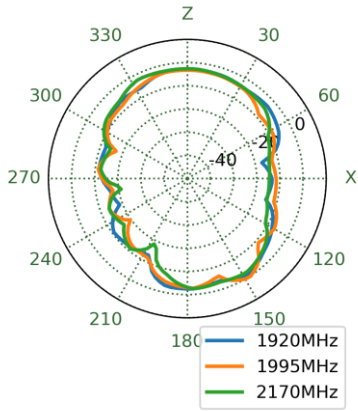
7.40 5G-4G-4 Patterns at 1910 MHz



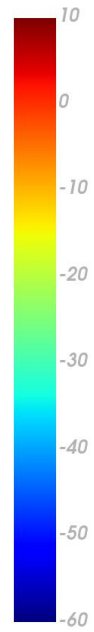
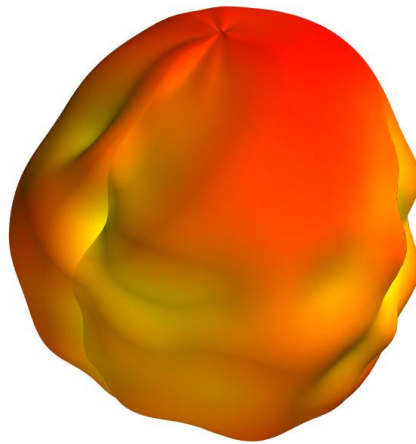
7.41 5G-4G-4 Patterns at 1995 MHz



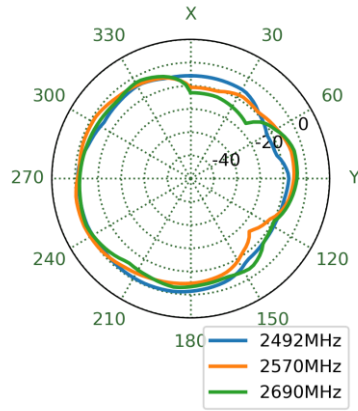
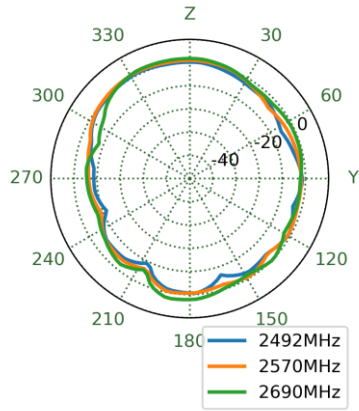
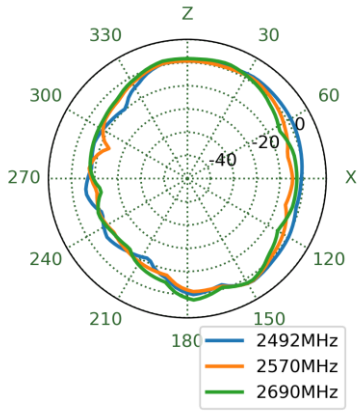
XZ Plane YZ Plane XY Plane



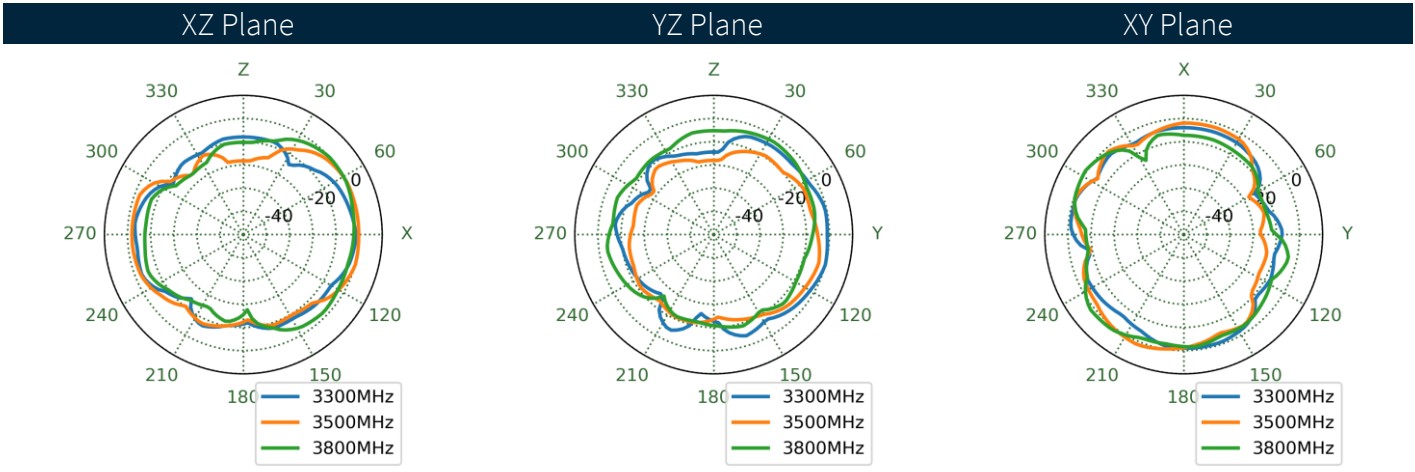
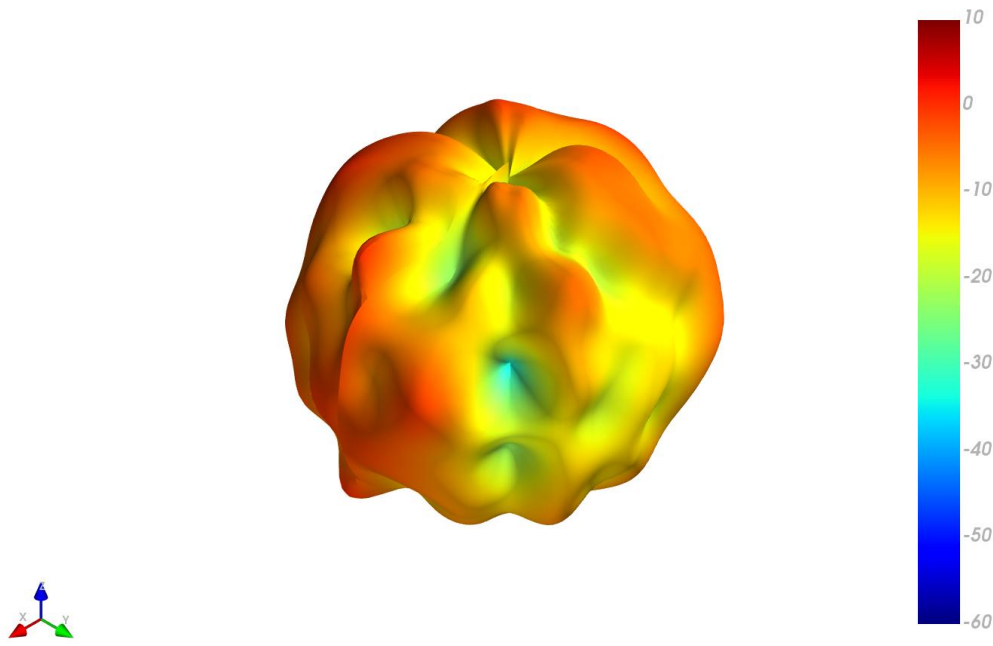
7.42 5G-4G-4 Patterns at 2570 MHz



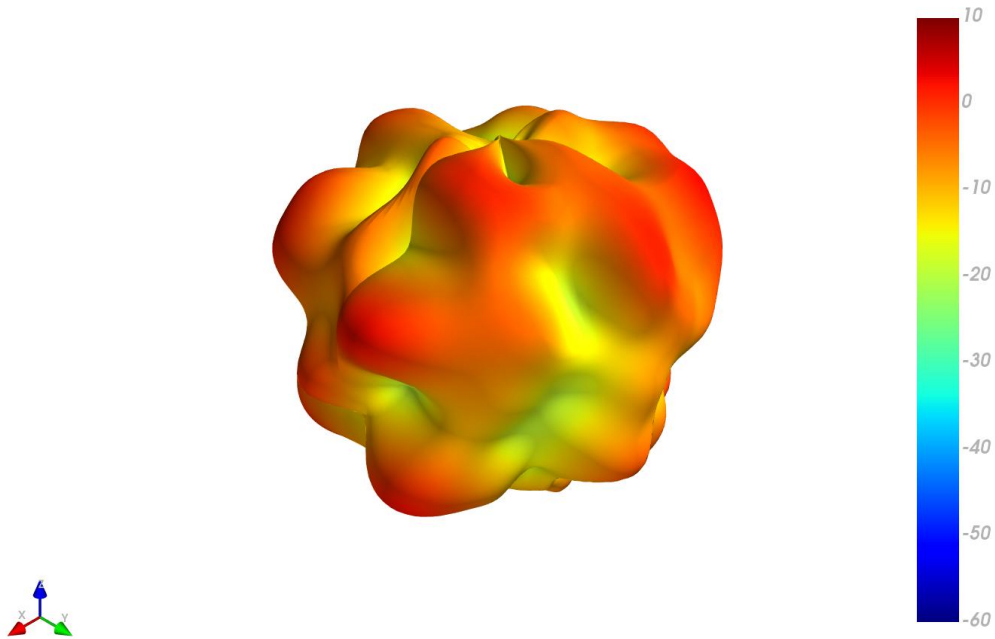
XZ Plane YZ Plane XY Plane



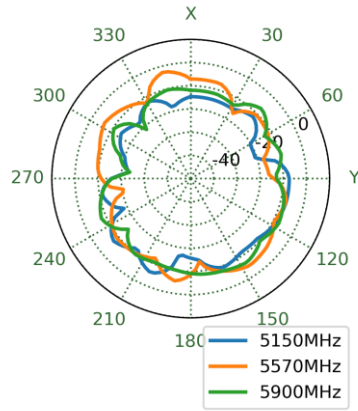
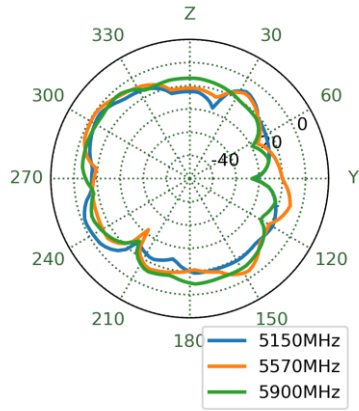
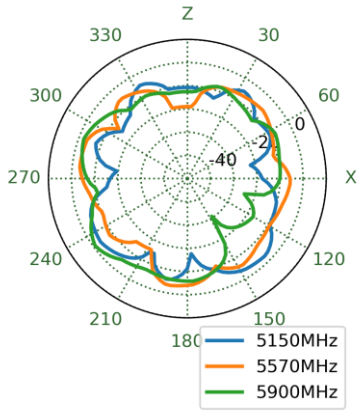
7.43 5G-4G-4 Patterns at 3500 MHz



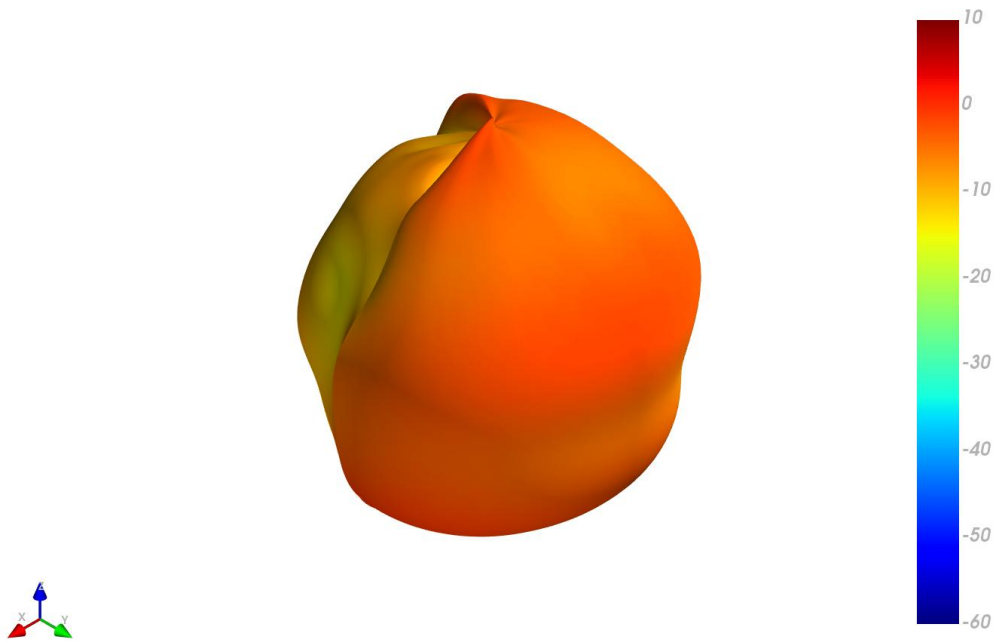
7.44 5G-4G-4 Patterns at 5570 MHz



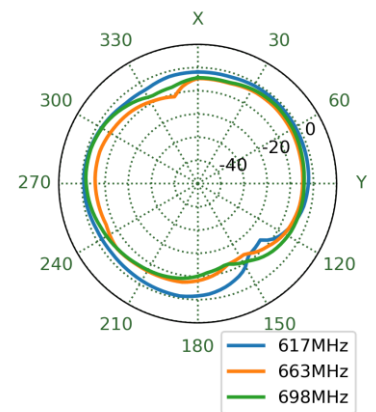
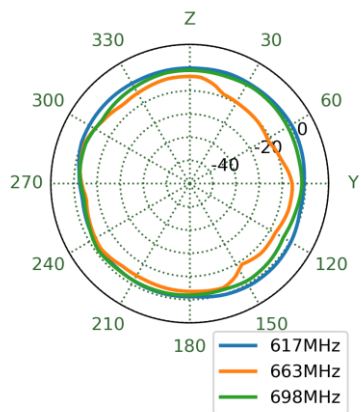
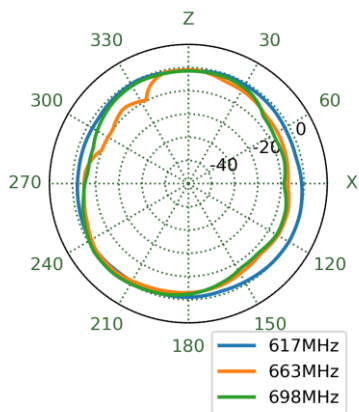
XZ Plane YZ Plane XY Plane



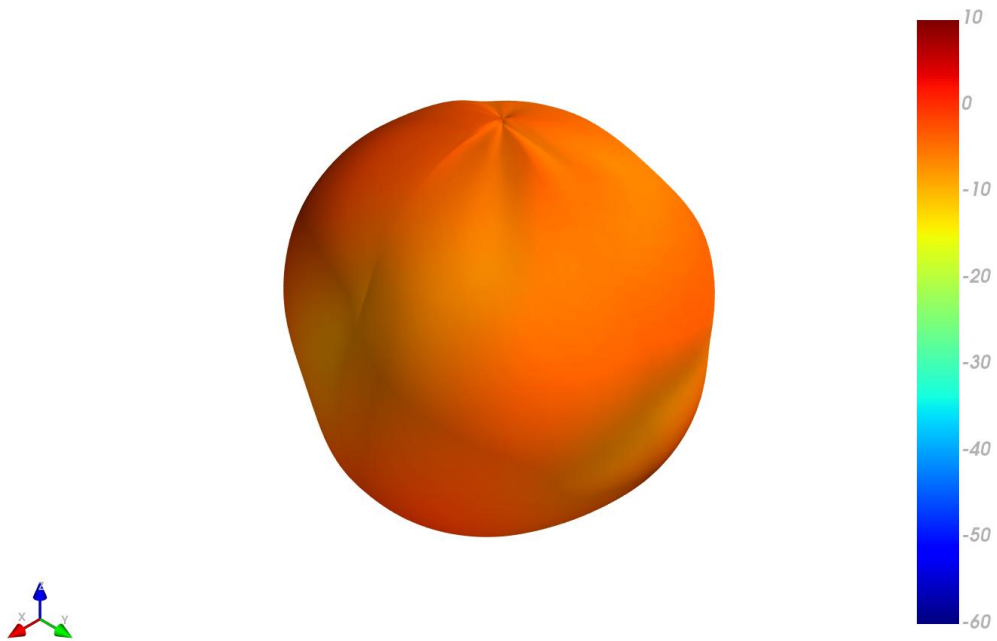
7.45 5G-4G-5 Patterns at 663 MHz



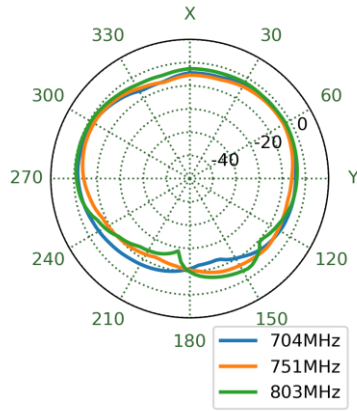
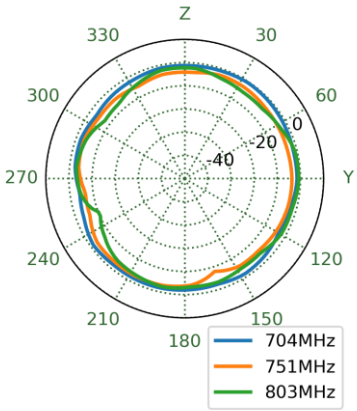
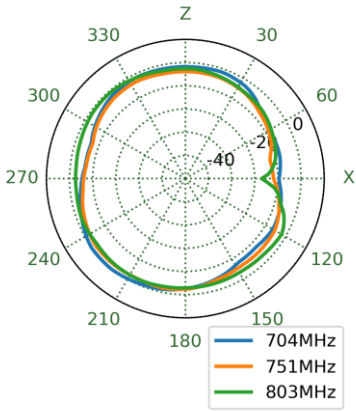
XZ Plane YZ Plane XY Plane



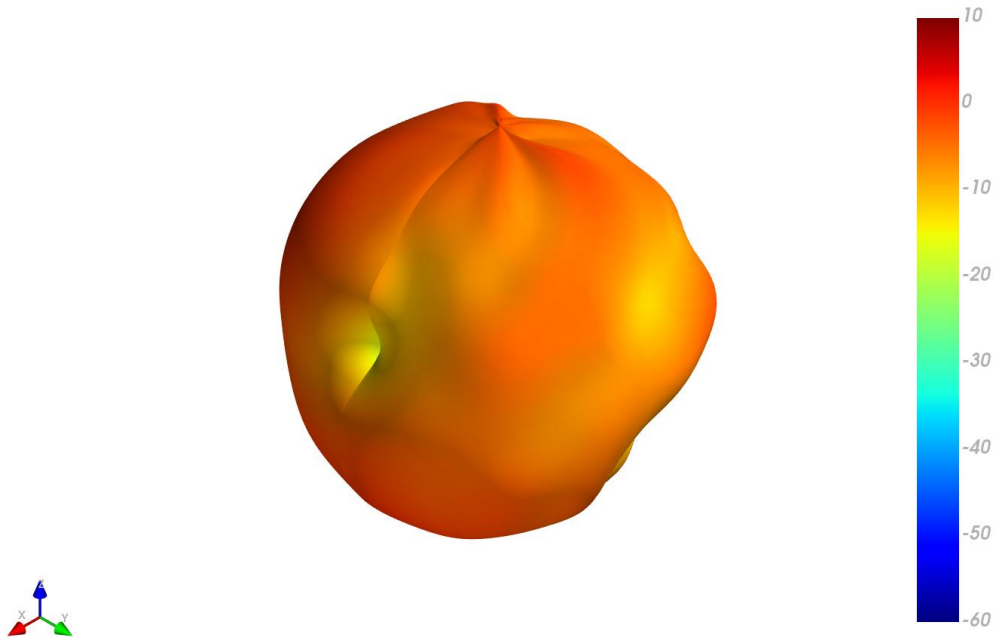
7.46 5G-4G-5 Patterns at 751 MHz



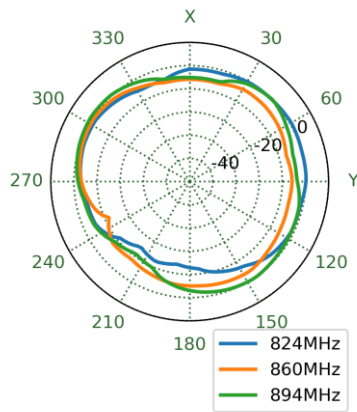
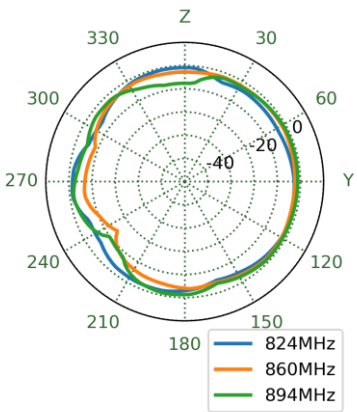
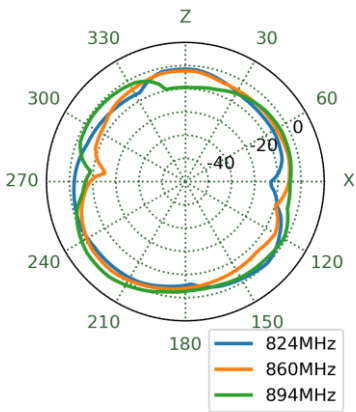
XZ Plane YZ Plane XY Plane



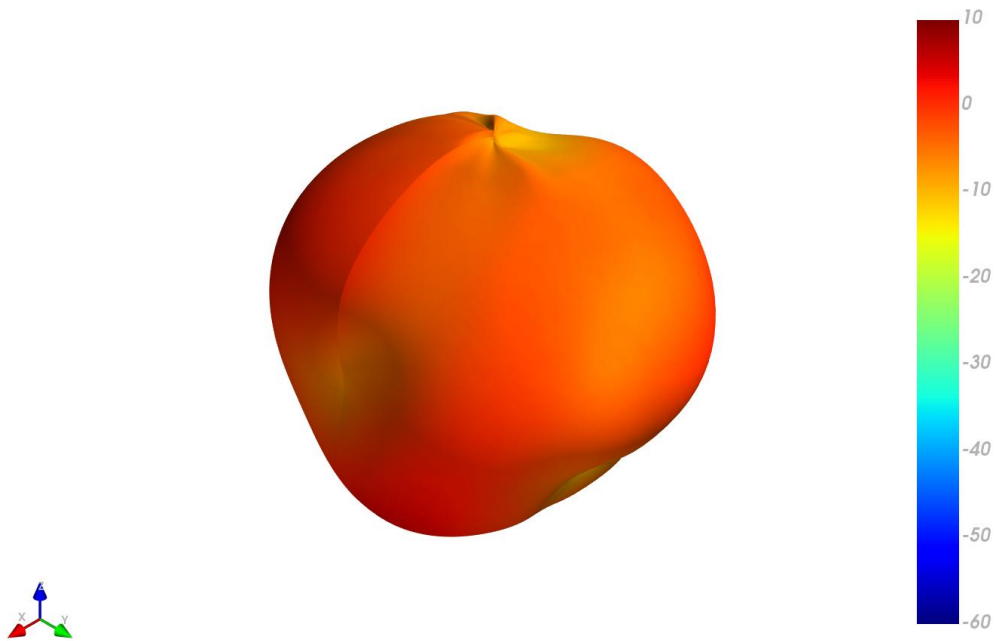
7.47 5G-4G-5 Patterns at 860 MHz



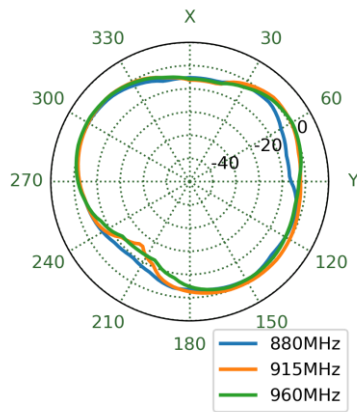
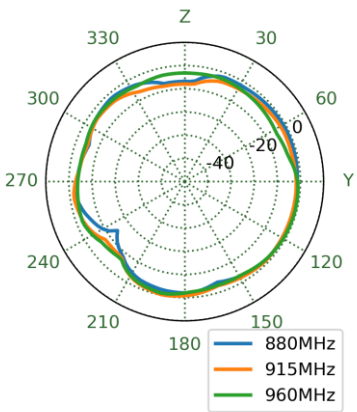
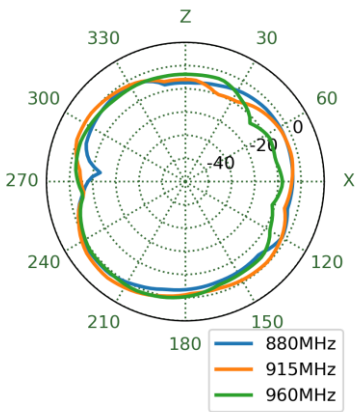
XZ Plane YZ Plane XY Plane



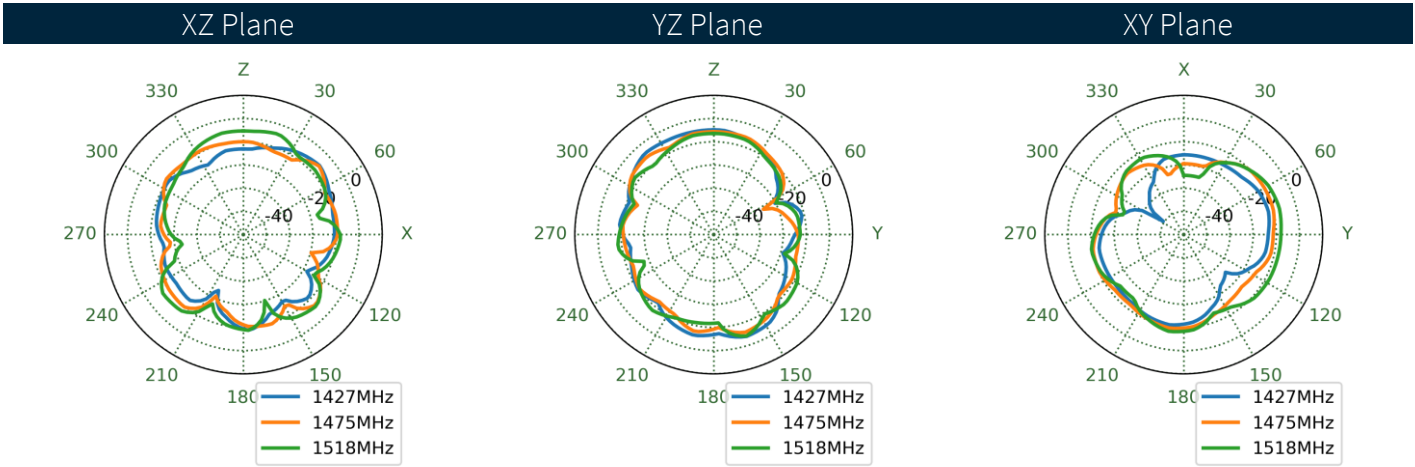
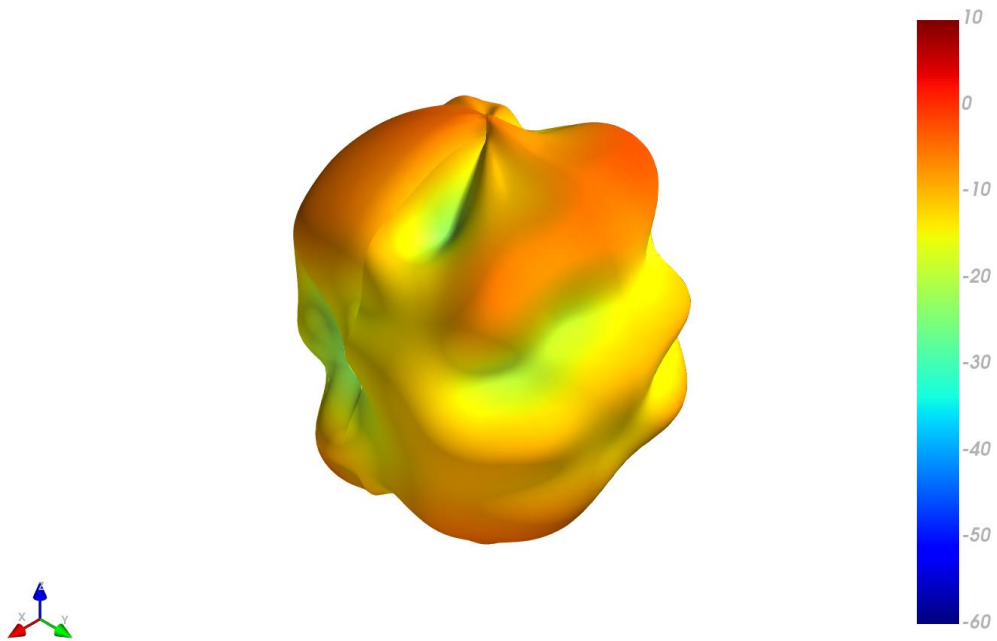
7.48 5G-4G-5 Patterns at 915 MHz



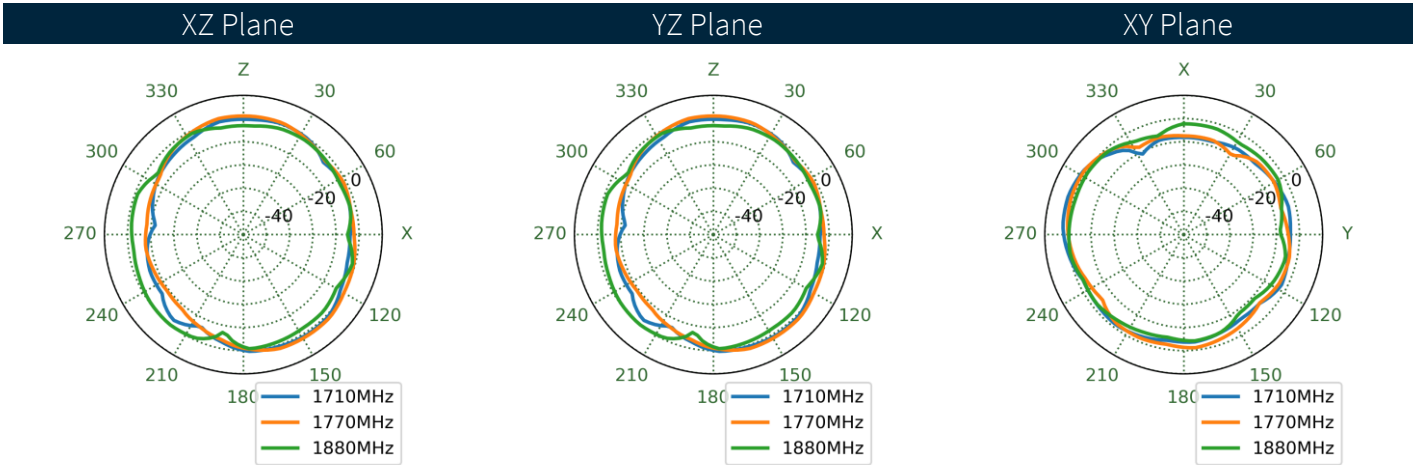
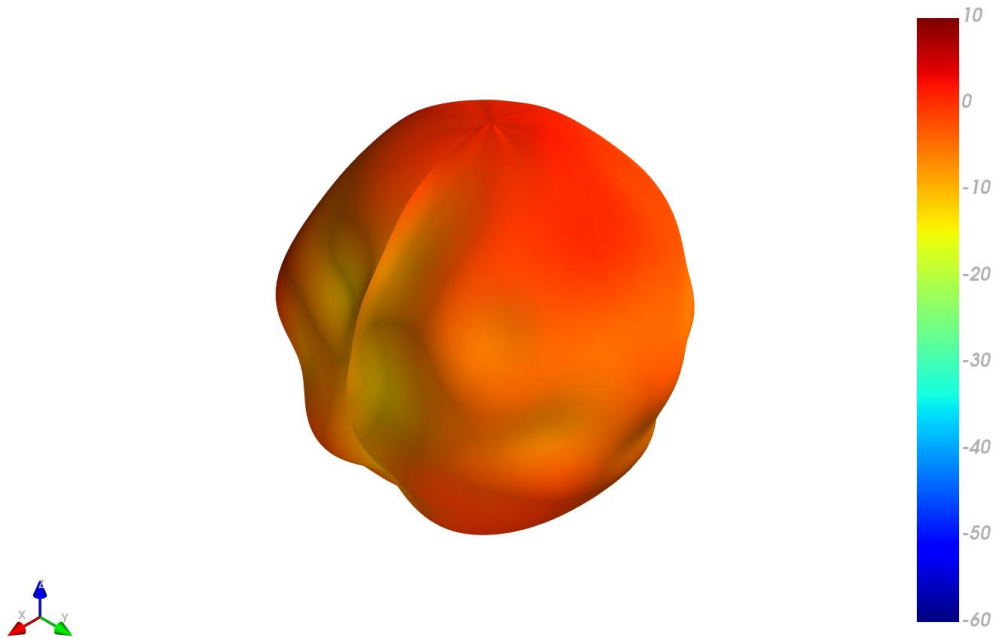
XZ Plane YZ Plane XY Plane



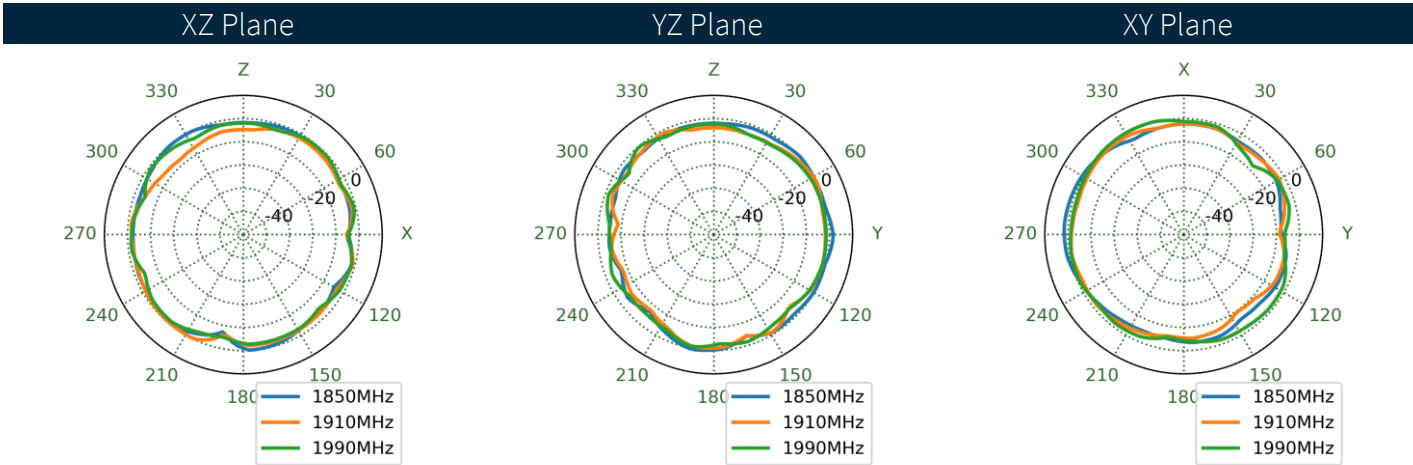
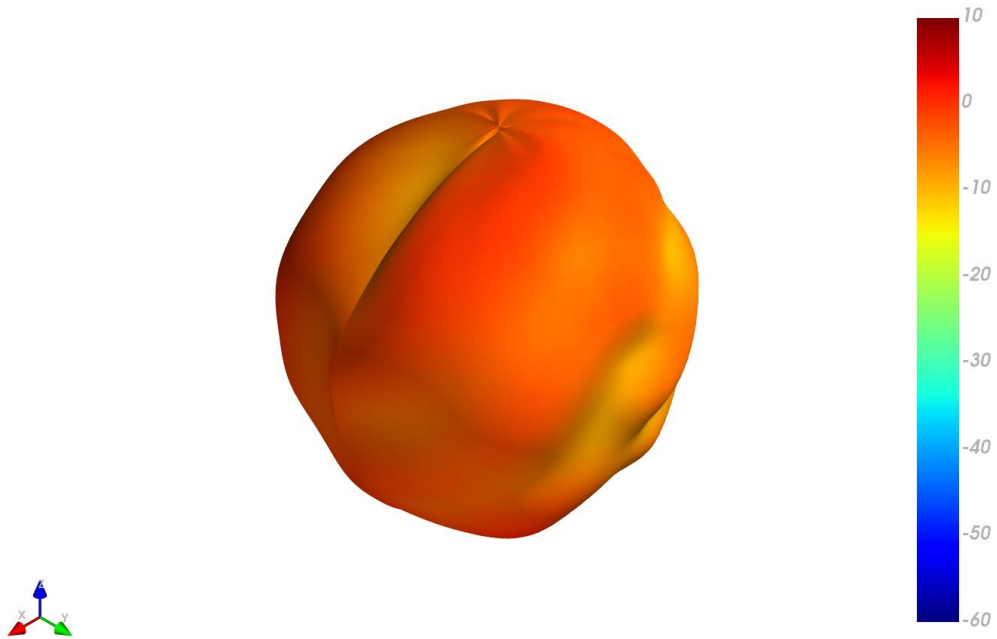
7.49 5G-4G-5 Patterns at 1475 MHz



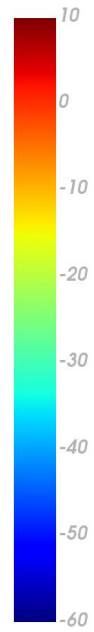
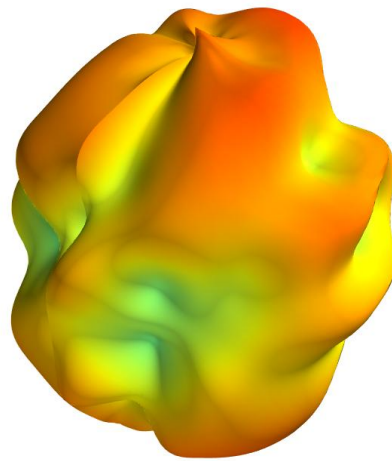
7.50 5G-4G-5 Patterns at 1770 MHz



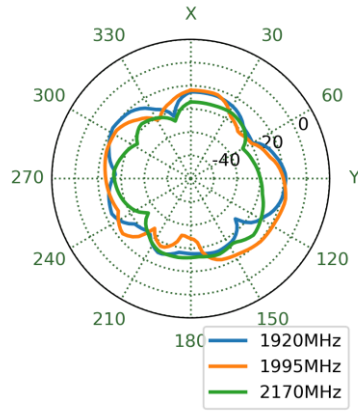
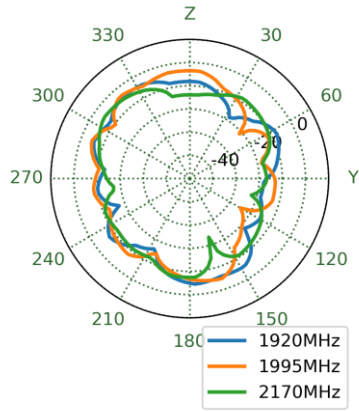
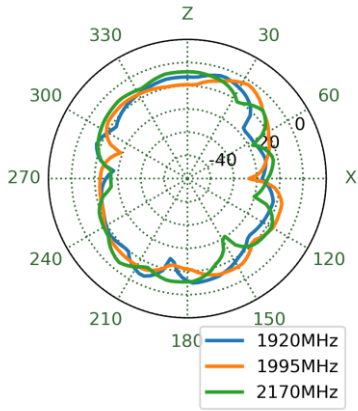
7.51 5G-4G-5 Patterns at 1910 MHz



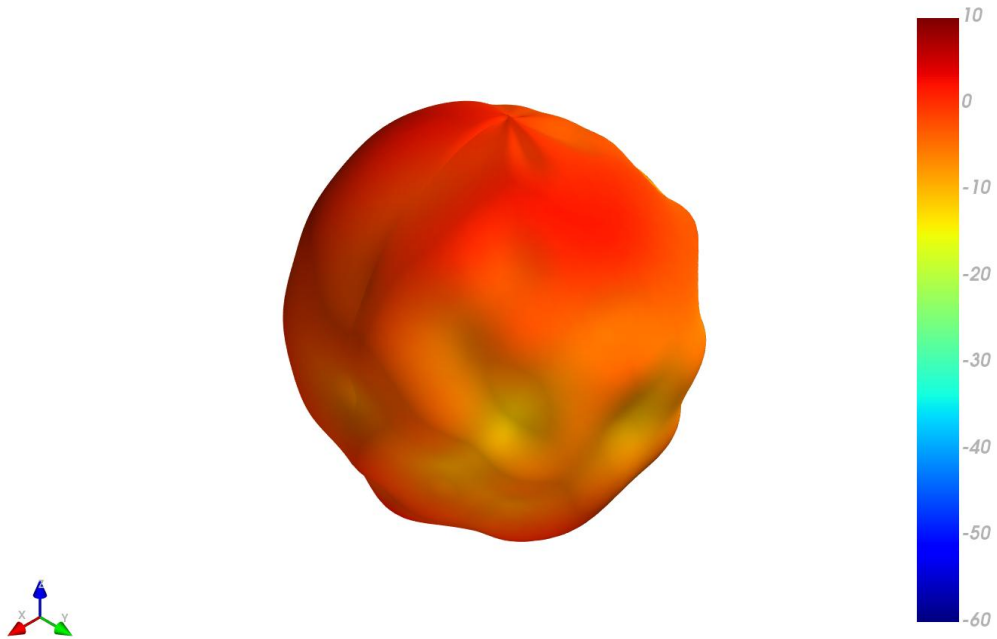
7.52 5G-4G-5 Patterns at 1995 MHz



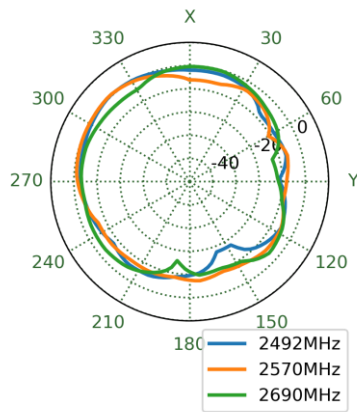
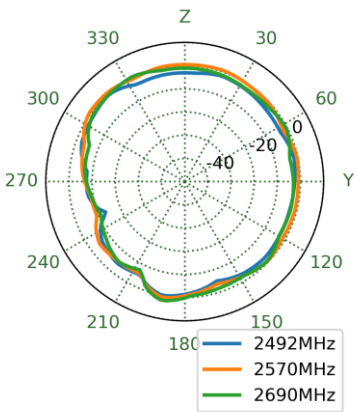
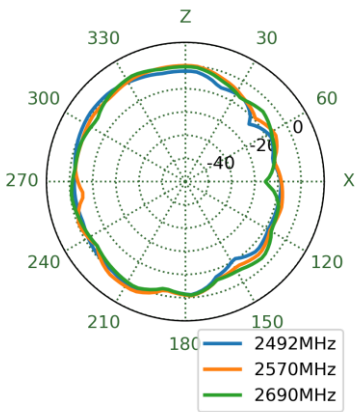
XZ Plane YZ Plane XY Plane



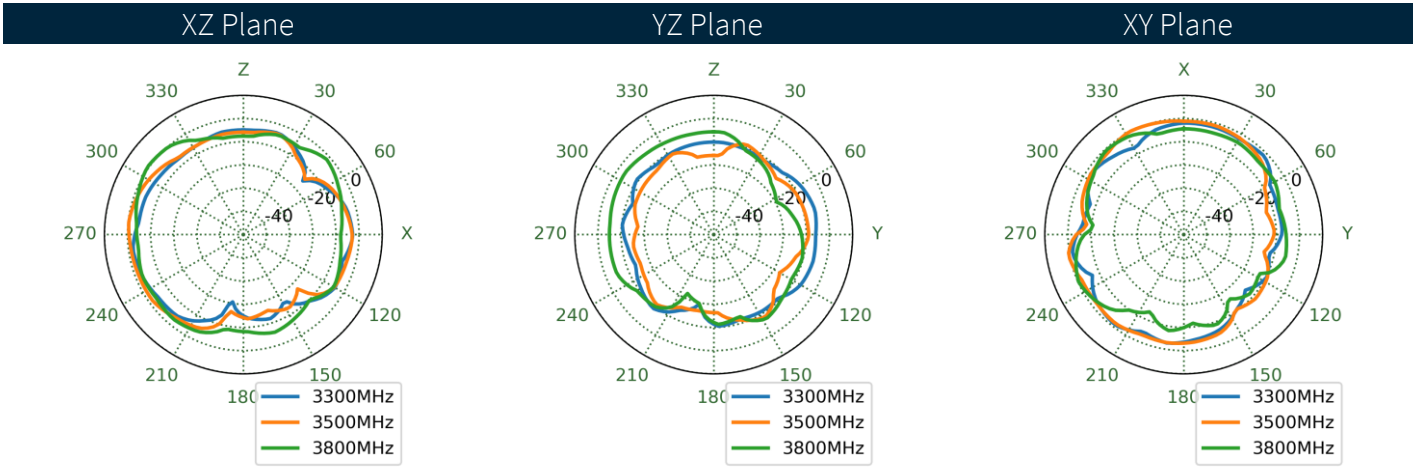
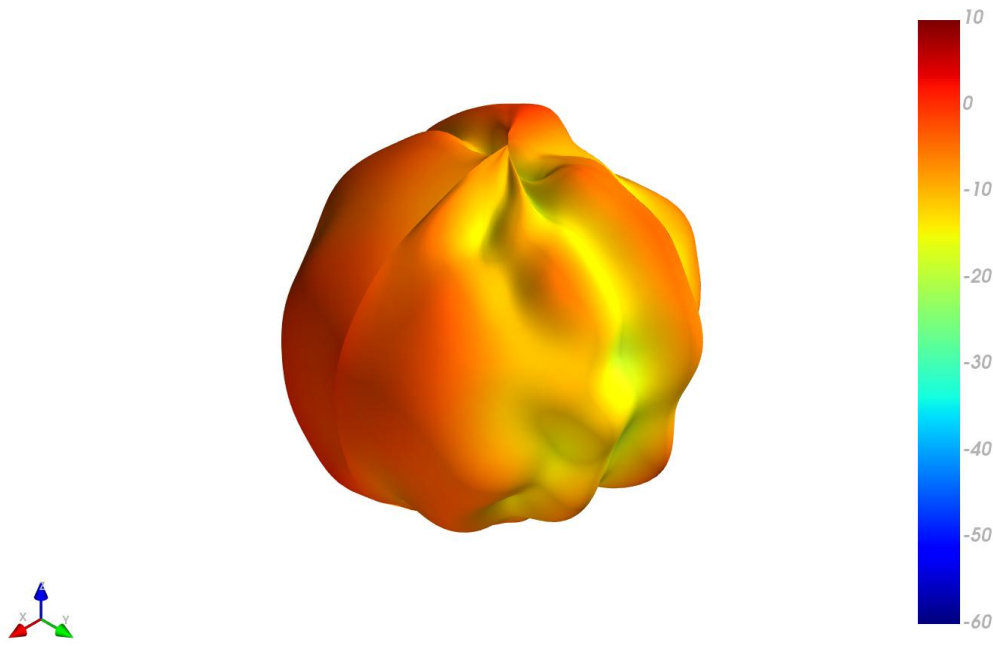
7.53 5G-4G-5 Patterns at 2570 MHz



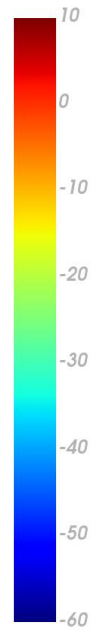
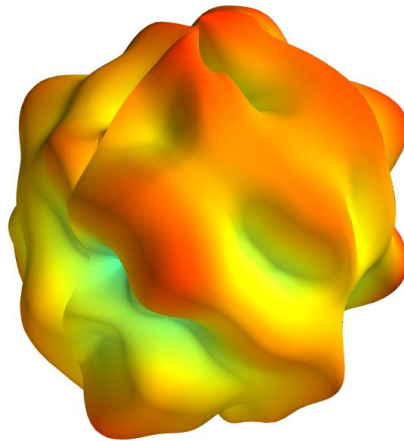
XZ Plane YZ Plane XY Plane



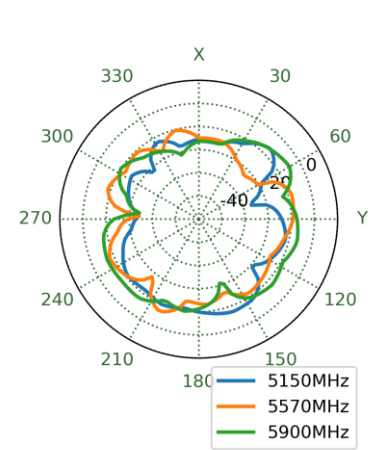
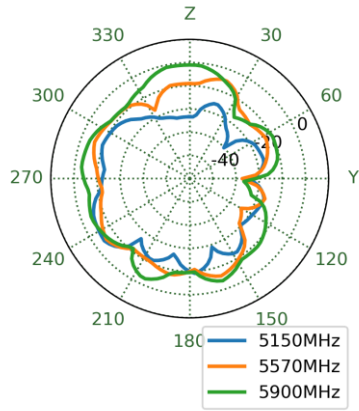
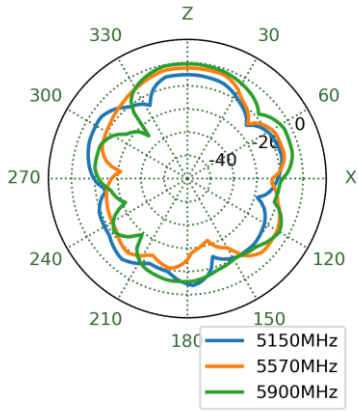
7.54 5G-4G-5 Patterns at 3500 MHz



7.55 5G-4G-5 Patterns at 5570 MHz



XZ Plane YZ Plane XY Plane



Changelog for the datasheet

SPE-22-8-017 – MA990.A.001

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Date:	2025-04-16
Changes:	Full Datasheet Update
Changes Made by:	Gary West

Previous Revisions

Revision: A (Original First Release)

Date:	2022-02-03
Notes:	
Author:	Jack Conroy



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