TAOGLAS



Datasheet

Synergy 9-in-1 Antenna

Part No:
MA1509.AK.005

Description

Synergy 9-in-1 GNSS SMA(M) 4 5G/4G SMA(M) 4 Wi-Fi RP-SMA(M) and braided cable assembly 5m TGC-200

Features:

4 x 5G/4G MIMO Antenna

4 x Wi-Fi 2.4GHz/5GHz MIMO Antenna

1 x GPS/GLONASS/BeiDou Antenna Front End GNSS SAW Filter

IP67 Rated Waterproof Enclosure

High Efficiency/Peak Gain Outdoor Antenna

Cable: 300mm RG-174 with 4700mm TGC-200

Connectors: SMA(M) / RP-SMA(M)

RoHS & REACH Compliant

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1. Introduction



The Taoglas Synergy MA1509 is a 9-in-1 next-generation permanent mount antenna for vehicle roof applications. It has a fully IP67 rated waterproof robust PC enclosure and base. The 9 antennas inside support 5G/4G, GPS/GLONASS/BeiDou, Wi-Fi (2.4GHz/5GHz). This outstanding patent-pending antenna delivers powerful MIMO antenna technology for 5G/4G, Wi-Fi 2.4/5.8GHz 802.11n and the emerging 802.11ac, and an optimized GPS/GLONASS/BeiDou patch antenna for location. The 5G/4G antennas also include backward compatibility to work at most worldwide 2G and 3G bands.

Typical Applications:

– Next Generation OEM Automotive Connectivity
– Multimedia, Navigation and Telematics Systems
– V2V, V2X and Fleet Management Applications
– Real-time HD Video Streaming
– First Net Responder Routers

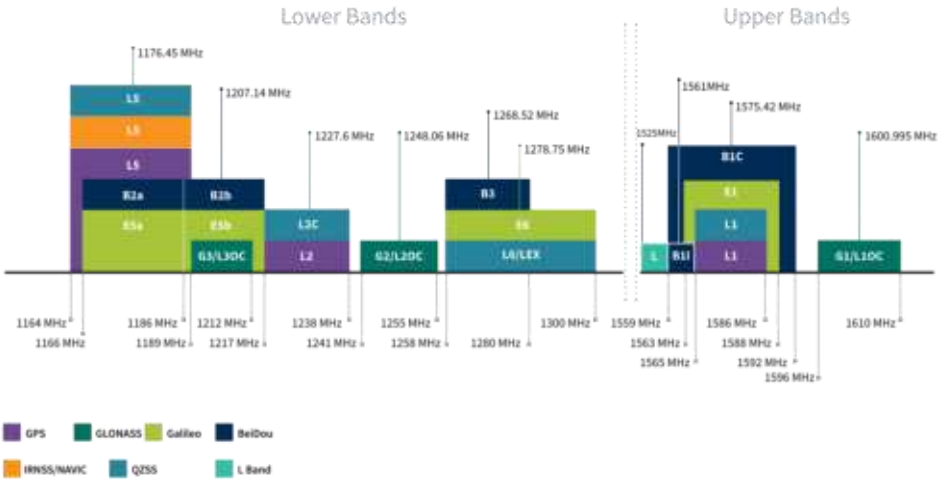
The MA1509 is ideal for applications that require highly sophisticated antennas for real-time streaming applications that demand high-speed video uplink and downlink into the cabin of the vehicle. These challenges are resolved by the highly efficient, high gain MIMO antennas, with high isolation, all of which is necessary to achieve the required signal to noise ratio and throughput.

The MA1509 can also be customized for your particular wireless application and frequency band, subject to NRE and MOQ. There are 8x 300mm RG-174 cables, terminating in SMA(M) connectors for 5G/4G MIMO 4X4, and RP SMA(M) for Wi-Fi MIMO 4X4. There is a 300mm RG-174 cable for GNSS terminating in an SMA(M) connector.

All cable lengths and connector types are customizable. The Synergy MA1509 can be supplied with low loss TGC-200 cable extensions for longer cable runs. Contact your regional Taoglas customer services team for details and support.

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)	**1561**	**1575.42**	**1602**
VSWR (max.)	2.5	2.5	2.5
Passive Antenna Efficiency (%) (Without cable loss)	40.02	48.39	44.29
Passive Antenna Gain at Zenith (dBic) (Without cable loss)	3.75	4.44	4.54
Axial Ratio (dB)	20	11	15
Polarization	RHCP		
Impedance	50Ω		
Cable	RG-174		
Connector	SMA(M)		

LNA and Fi4G-5Gr Electrical Properties			
Frequency (MHz)	**1561**	**1575.42**	**1602**
VSWR (max.)	2.0:1	2.0:1	2.0:1
Gain@1.8V	28.8 dB	28.8 dB	28 dB
Gain@3.0V	29 dB	29 dB	28.3 dB
Gain@5.5V	29.6 dB	29.4 dB	28.7 dB
Noise@1.8V	2.8 dB	2.3 dB	2.8 dB
Noise@3.0V	2.8 dB	2.2 dB	2.8 dB
Noise@5.5V	2.9 dB	2.3 dB	2.8 dB
Power consumption@1.8V	8.7 mA		
Power consumption@3.0V	9.0 mA		
Power consumption@5.5V	11 mA		

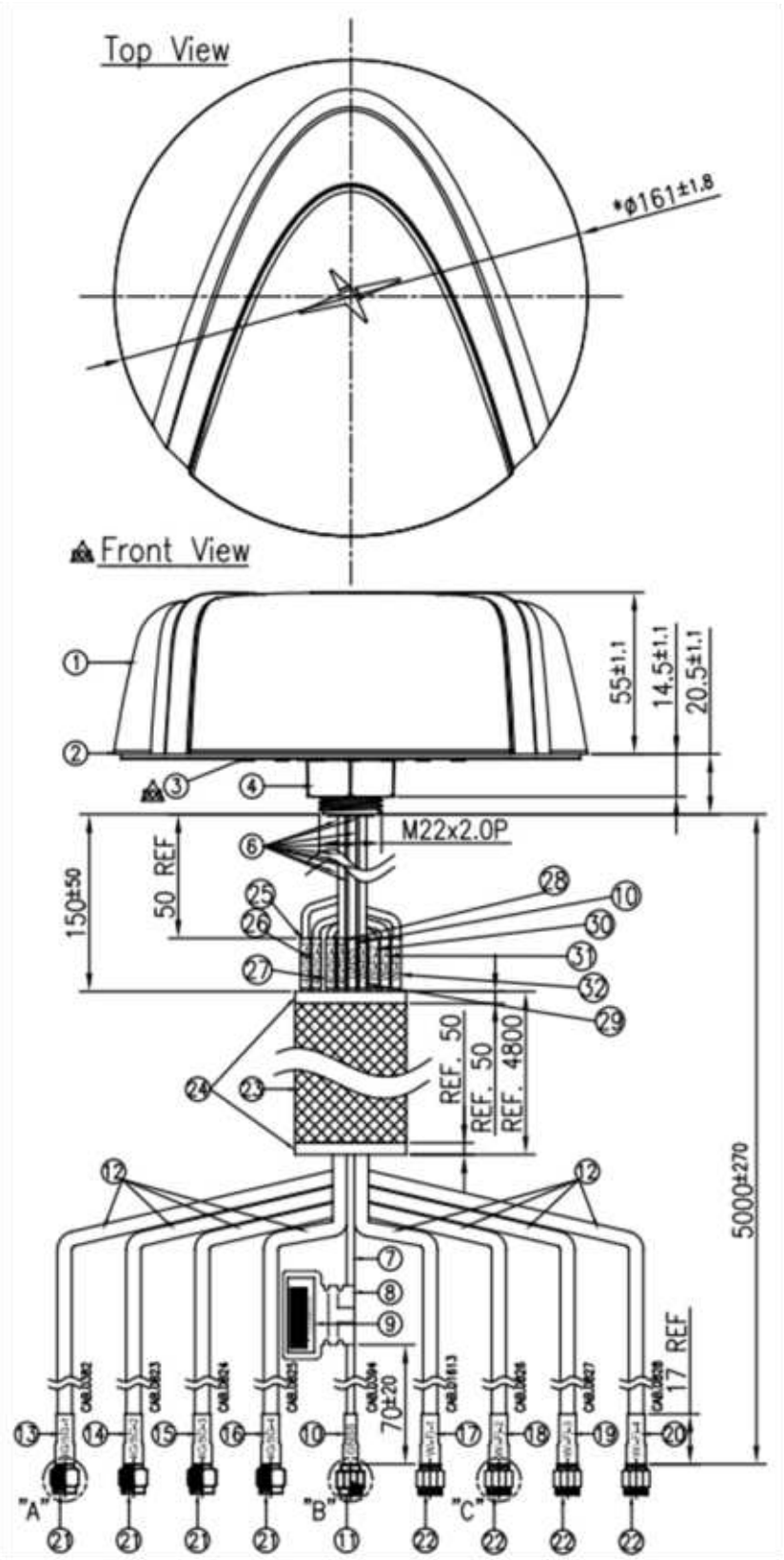
Total Specification (Through Antenna, SAW Fi4G-5Gr and LNA)			
Frequency (MHz)	**1561**	**1575.42**	**1602**
Gain@3V (dBic)	31.7 ± 3	32.4 ± 3	32.4 ± 3
Output Impedance	50Ω		

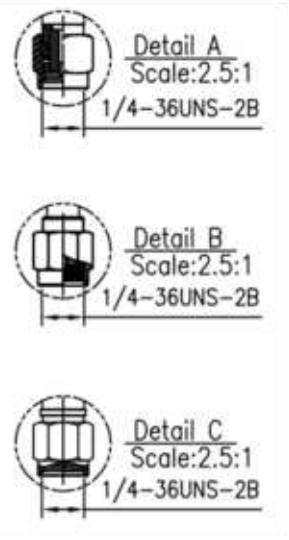
4G-5G Electrical									
Band	Frequency (MHz)	Measurement	Efficiency (%)	Average Gain (dB)	Peak Gain (dBi)	Impedance	Polarization	Radiation Pattern	Max. input power
5GNR/4G Band71	617-698	4G-5G 1	23.6	-6.28	0.16	50 Ω	Linear	Omni directional	10W
		4G-5G 2	29.3	-5.34	0.89				
		4G-5G 3	22.8	-6.43	-1.16				
		4G-5G 4	25.6	-5.92	0.64				
4G/3G Band 12,13,14,17,28,29	698-824	4G-5G 1	34.7	-4.59	1.90				
		4G-5G 2	39.8	-4.00	2.37				
		4G-5G 3	41.2	-3.85	2.70				
		4G-5G 4	34.7	-4.60	1.57				
4G/3G/NB-IoT/Cat M Band 5,8,18,19,20,26,27	824-960	4G-5G 1	37.3	-4.28	3.18				
		4G-5G 2	41.3	-3.84	3.11				
		4G-5G 3	44.7	-3.49	4.26				
		4G-5G 4	33.1	-4.80	3.50				
5GNR/4G Band 21,32,74,75,76	1427-1518	4G-5G 1	43.4	-3.62	3.53				
		4G-5G 2	44.6	-3.51	4.11				
		4G-5G 3	40.3	-3.95	3.13				
		4G-5G 4	43.3	-3.64	3.57				
4G/3G Band 1,2,3,4,9,23,25,35,39, 66	1710-2200	4G-5G 1	33.5	-4.75	4.37				
		4G-5G 2	32.6	-4.87	3.01				
		4G-5G 3	38.4	-4.16	6.24				
		4G-5G 4	35.6	-4.48	4.73				
4G/3G Band 7,30,38,40,41	2300-2690	4G-5G 1	45.9	-3.39	4.86				
		4G-5G 2	40.6	-3.92	4.28				
		4G-5G 3	48.2	-3.17	5.75				
		4G-5G 4	42.5	-3.72	5.07				
LTE5200/Wi-Fi5800	5150-5925	4G-5G 1	53.1	-2.75	7.14				
		4G-5G 2	62.5	-2.04	7.47				
		4G-5G 3	62.4	-2.05	8.57				
		4G-5G 4	57.6	-2.40	8.79				
5GNR/4G Band 22,42,48,77,78,79	3300-5000	4G-5G 1	44.3	-3.53	7.07				
		4G-5G 2	51.6	-2.87	7.88				
		4G-5G 3	43.6	-3.61	6.04				
		4G-5G 4	40.8	-3.89	6.35				

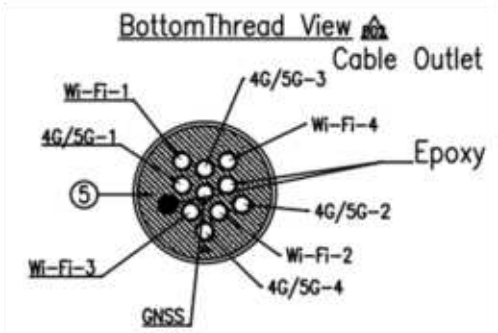
Wi-Fi Electrical									
Band	Frequency (MHz)	Measurement	Efficiency (%)	Average Gain (dB)	Peak Gain (dBi)	Impedance	Polarization	Radiation Pattern	Max. input power
Wi-Fi - 2GHz	2400-2500	Wi-Fi 1	46.3	-3.35	3.38	50 Ω	Linear	Omni directional	10W
		Wi-Fi 2	48.4	-3.15	4.49				
		Wi-Fi 3	39.9	-3.99	3.51				
		Wi-Fi 4	36.7	-4.35	3.06				
Wi-Fi - 5GHz	5150-5850	Wi-Fi 1	54.5	-2.63	6.52				
		Wi-Fi 2	57.8	-2.38	7.10				
		Wi-Fi 3	52.3	-2.82	6.18				
		Wi-Fi 4	54.4	-2.64	6.64				
Wi-Fi - 6GHz	5925-7125	Wi-Fi 1	59.9	-2.23	7.73				
		Wi-Fi 2	50.0	-3.01	7.02				
		Wi-Fi 3	39.8	-4.00	5.99				
		Wi-Fi 4	38.9	-4.10	6.42				

Mechanical	
Height	57.47mm
Planner Dimension	Ø160mm
Casing	PC
Cable	0.3m RG-174 with 4.7m TGC-200 for 5G/4G – Fully Customizable 0.3m RG-174 with 4.7m TGC-200 for Wi-Fi – Fully Customizable 0.3m RG174 with 4.7m TGC-200 for GNSS – Fully Customizable
Connector	5G/4G_SMA-Plug – Fully Customizable Wi-Fi_RP-SMA-Plug – Fully Customizable GNSS_SMA-Plug – Fully Customizable
Thread Diameter	M22
Waterproof	IP67
Sealant	Rubber Stopper and O-Ring
Weight	2.7Kg
Environmental	
Ingress Protection	IP67
Temperature Range	-40°C to 85°C
Humidity	Non-condensing 65°C 95% RH
Cable Pull	RG-174 4 Kg

3. Mechanical Drawing







		Name	Material	Finish	QTY
	1	Top Plastic Shell	PC	Black / Grey	1
	2	Bottom Plastic	PC	Black	1
⚠02	3	Double Sided Adhesive	EX3943X IMS 1X	Black Foam/White Liner	1
	4	Nut_M22	Nylon	Black	1
	5	Rubber	Silicone Rubber	Black	1
	6	RG174 Coaxial Cable (IMS39AA00)	PVC	Black	9
	7	RG174 Coaxial Cable (CNBL0304)	PVC	Black	1
	8	Empty Label	PEPA	White	1
	9	Barcode Label	PET	White	1
	10	Heat Shrink Tube (GNSS)	PE	Blue Tube/White Text	2
	11	SMA(M)ST	Brass	Au Plated	1
	12	TGC-200 Coaxial Cable	PE	Black	8
	13	Heat Shrink Tube (4G/5G-1)	PE	Red Tube/White Text	1
	14	Heat Shrink Tube (4G/5G-2)	PE	Red Tube/White Text	1
	15	Heat Shrink Tube (4G/5G-3)	PE	Red Tube/White Text	1
	16	Heat Shrink Tube (4G/5G-4)	PE	Red Tube/White Text	1
	17	Heat Shrink Tube (Wi-Fi-1)	PE	Yellow Tube/Black Text	1
	18	Heat Shrink Tube (Wi-Fi-2)	PE	Yellow Tube/Black Text	1
	19	Heat Shrink Tube (Wi-Fi-3)	PE	Yellow Tube/Black Text	1
	20	Heat Shrink Tube (Wi-Fi-4)	PE	Yellow Tube/Black Text	1
	21	SMA(M)ST	Brass	Au Plated	4
	22	SMA(M)ST_RP	Brass	Au Plated	4
	23	Centenary Braid	BSPET	Black	1
	24	Heat Shrink Tube	PE With Glue	Black	2
	25	Heat Shrink Tube (4G/5G-1)	PE	Red Tube/White Text	1
	26	Heat Shrink Tube (4G/5G-2)	PE	Red Tube/White Text	1
	27	Heat Shrink Tube (4G/5G-3)	PE	Red Tube/White Text	1
	28	Heat Shrink Tube (4G/5G-4)	PE	Red Tube/White Text	1
	29	Heat Shrink Tube (Wi-Fi-1)	PE	Yellow Tube/Black Text	1
	30	Heat Shrink Tube (Wi-Fi-2)	PE	Yellow Tube/Black Text	1
	31	Heat Shrink Tube (Wi-Fi-3)	PE	Yellow Tube/Black Text	1
	32	Heat Shrink Tube (Wi-Fi-4)	PE	Yellow Tube/Black Text	1

4. Installation Guidelines

A Introduction

The Taoglas Synergy is an external permanent mount combination antenna that can be provided with combinations of 5G/4G, active GNSS with front end saw and dual-band Wi-Fi. The Synergy is available with two versions of the enclosure, one designed specifically for the Ford Interceptor, both supplied with 3M adhesive, along with an M22 threaded boss for surface attachment. The Synergy is ideal for vehicle panels of up to 6mm(0.23") thick with a threaded boss length of 20.5mm(0.81"). The Synergy is IP67 rated and includes an O-Ring to seal from any water ingress.



Electrical Safety
The Synergy contains an active GPS/GNSS antenna.
Rated voltage: 3-5VDC Rated current: 20mA maximum
The supply to this device must be provided with overcurrent protection of 1A maximum.

Power consumption@1.8V (mA) 8.7 mA
Power consumption@3.0V (mA) 9.0 mA
Power consumption@5.5V (mA) 11 mA

B Mounting & Location

For prime performance, the Synergy is recommended to be fitted on a conductive metal panel. When fitting on a non-metallic panel, a conductive metal ground plane of suitable size should be fitted underneath the mounting panel to achieve a better level of performance. Optimum ground plane size is 300mm x 300mm(11.8" x 11.8"). When mounting on a vehicle roof panel ensure to mount on a flat surface, and measure for central position. Care should be taken to mount the Synergy antenna as far as possible from other roof-mounted features such as the aircon unit, light bar etc.

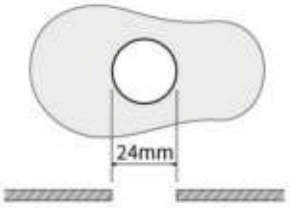


Sealing
In order to ensure that the installation is properly sealed against the mounting surface care must be taken regarding curvature of the mounting panel. It is highly recommended to install the antenna on a clean, flat and level surface. After installation the compression of the rubber boot against the mounting panel should be checked and a small bead of neutral cure silicone sealant can be applied around the periphery of the mounting boot if required.

C Surface Preparation

When preparing to drill the hole, mask the area around the hole position to protect the surface. Drill a pilot hole and increase the hole size to ø24mm (⅞"). Ensure the drill bit does not contact the headliner. Deburr and clean the area around the hole carefully removing all waste.

Remove paint and primer from under panel surface to ensure adequate contact with washer and nut. Apply petroleum jelly or paint around cut edge of the hole to prevent corrosion



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D Adhesive Patch

On the underside of the antenna there is a 3M adhesive patch. Peel away the 3M adhesive protection and feed the cables through the hole. Position the antenna over the hole and press down onto the panel with pressure. This adhesion will make ensure will be securely mounted and will also allow for extremely minimal curvature on the roof of a vehicle.



E Securing the Mount

A split nut is used to easily fit onto the thread through the cables. The nut is attached from the underside of the panel, it should easily twist onto the thread and then secured in place with a final tighten with a spanner. After tightening, double check the antenna to make sure that it is properly secured but take care not to over tighten, damaging the threads on the screw.



F Cable Routing and Connection

The Cables supplied are RG-174 for the GNSS feed and TGC-200 for the other feeds. The heatshrink will denote which cable is which for ease of installation. Connect each individual connector to the correct port of the router, if any cable is unused please fit a 50Ω terminator to the individual connection.



G Notices

Caution
To comply with FCC RF Exposure requirements in section 1.1310 of the FCC Rules, antennas used with this device must be installed to provide a separation distance of at least 20 cm from all persons to satisfy RF exposure compliance.

Warning
Do not operate the equipment in an explosive atmosphere.

European Waste Electronic Equipment Directive 2012/19/EU
Please ensure that your old Waste Electricals and Electronics are recycled do not throw them away into standard waste.

Hazardous Substances Directive (RoHS) 2011/65/EU / 2015/863/EU
Radio Equipment Directive (RED) 2014/53/EU

Harmonised Standards and References:
EN 301 489-1 (V2.2.3): ElectroMagnetic Compatibility (EMC) standard for radio equipment and services;
Part 1: Common technical requirements; Harmonised Standard for ElectroMagnetic Compatibility

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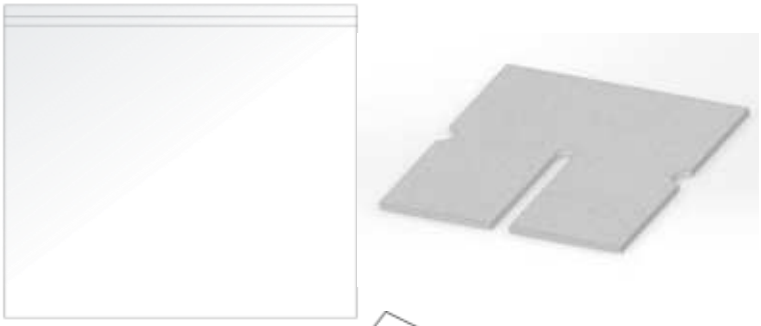
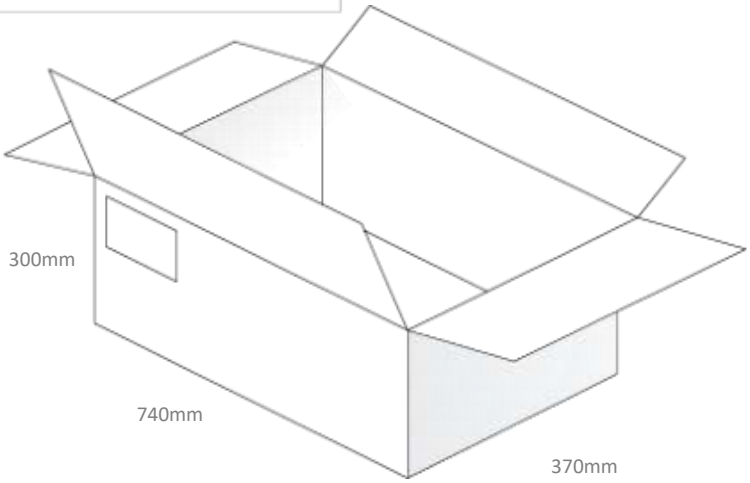
5. Packaging



1pc MA1509.AK.005 per PE Bag
Weight: 2.7Kg

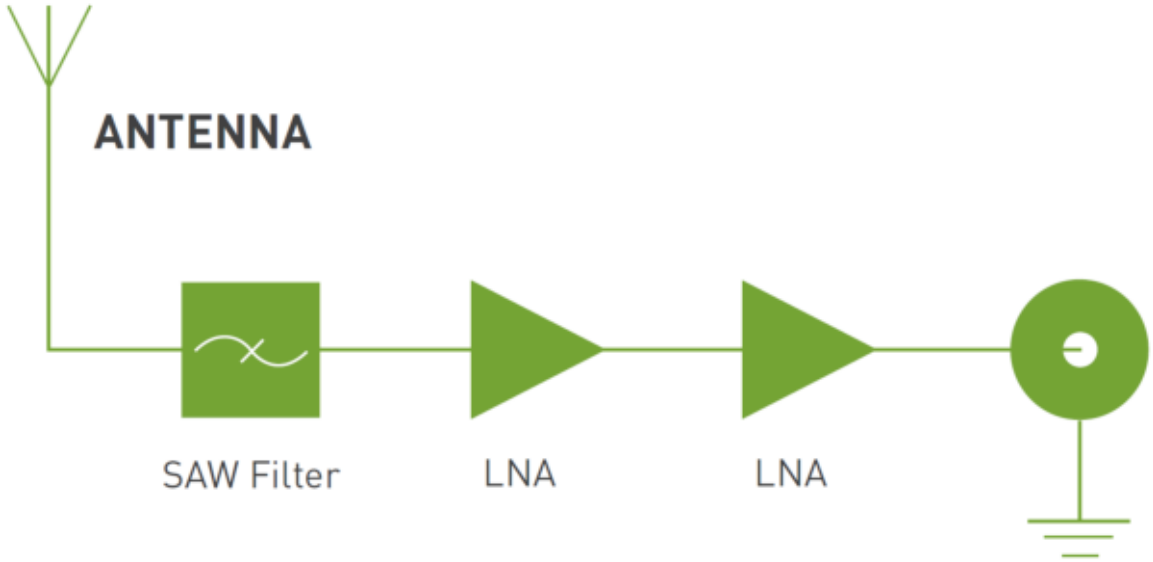


4pcs MA1509.AK.005 per Carton
Carton Dimensions: 740 x 370 x 300mm
Weight: 11.6Kg

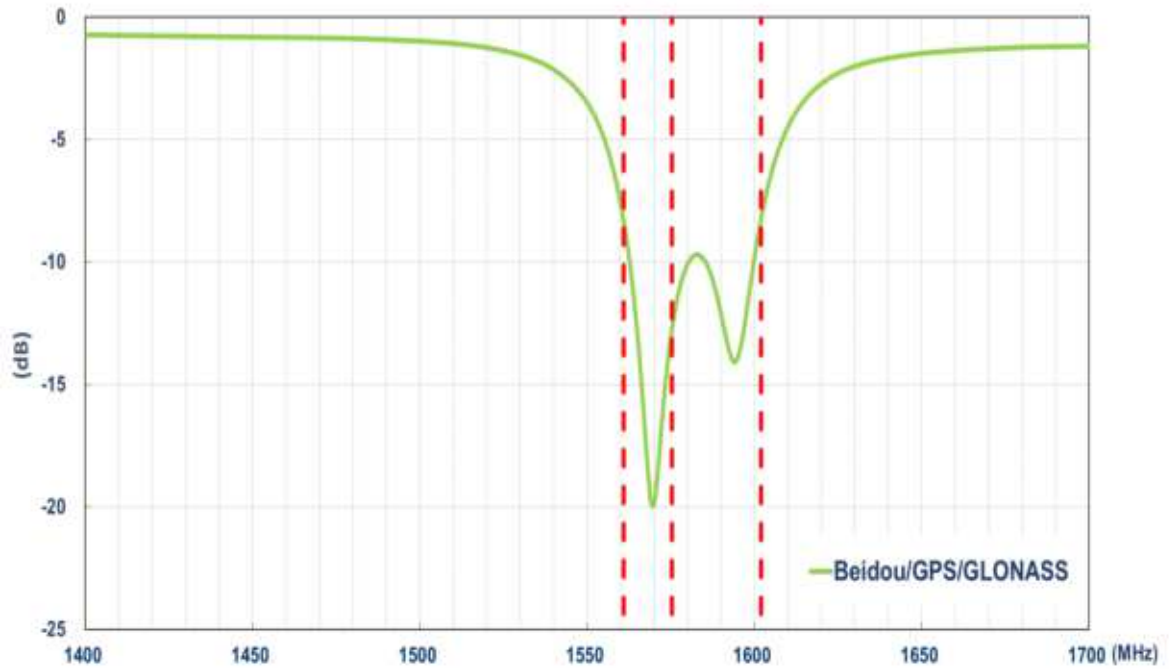


6. Antenna Characteristics

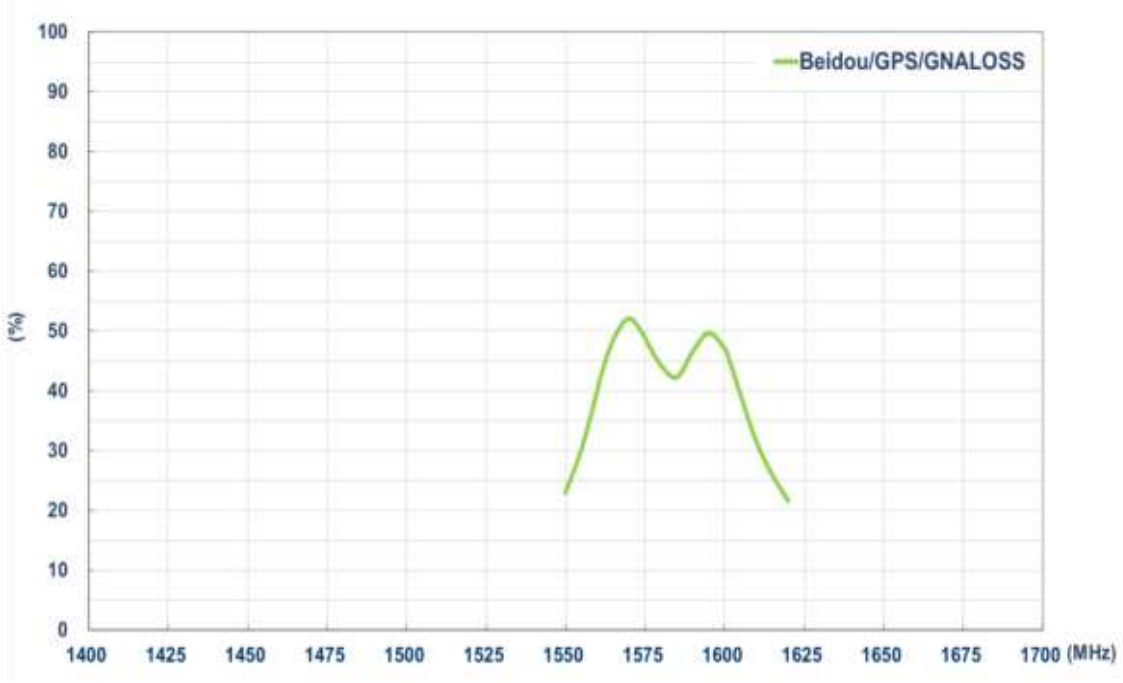
6.1 Block Diagram (Active Antenna)



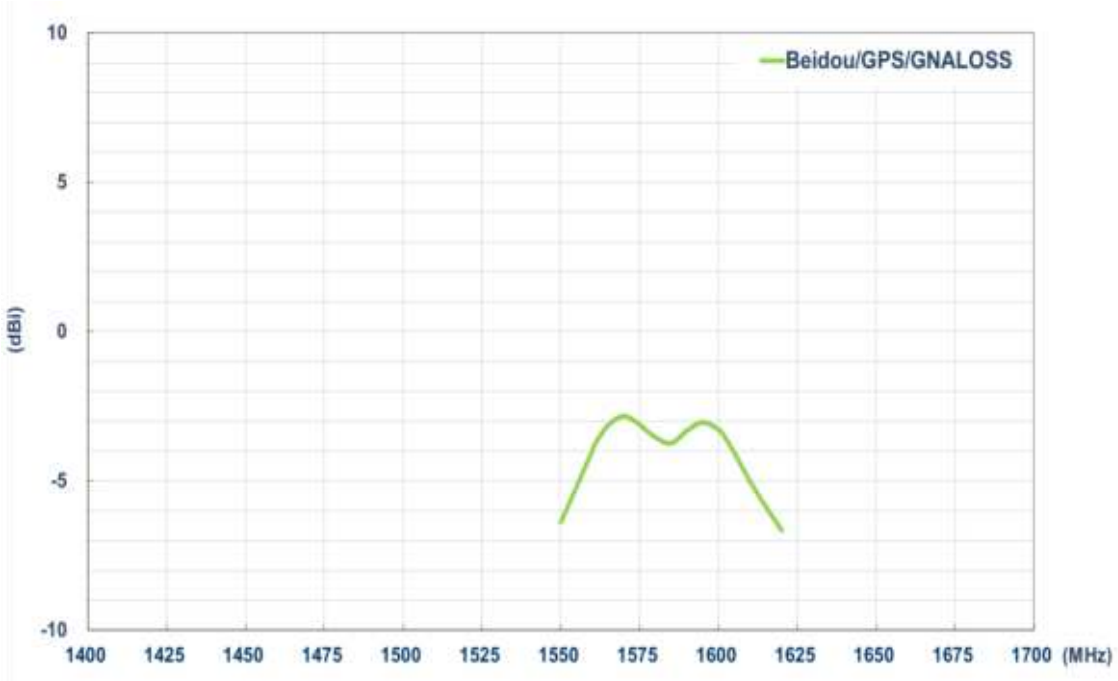
6.2 GNSS – Return Loss (Passive)



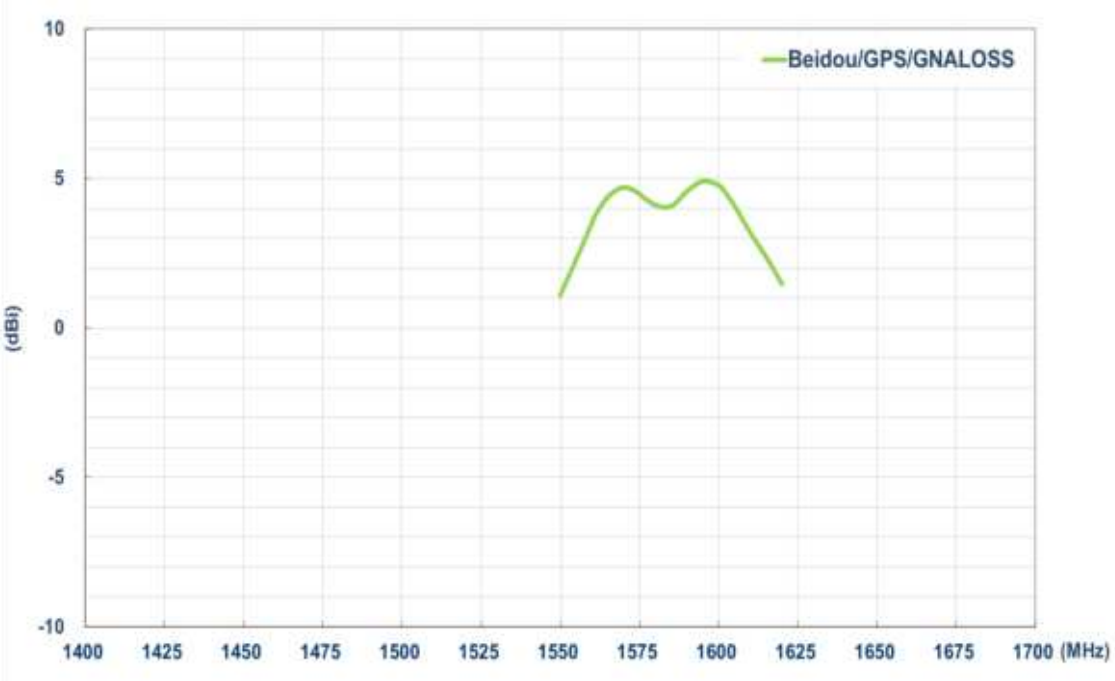
6.3 GNSS – Efficiency (Passive)



6.4 GNSS – Average Gain (Passive)

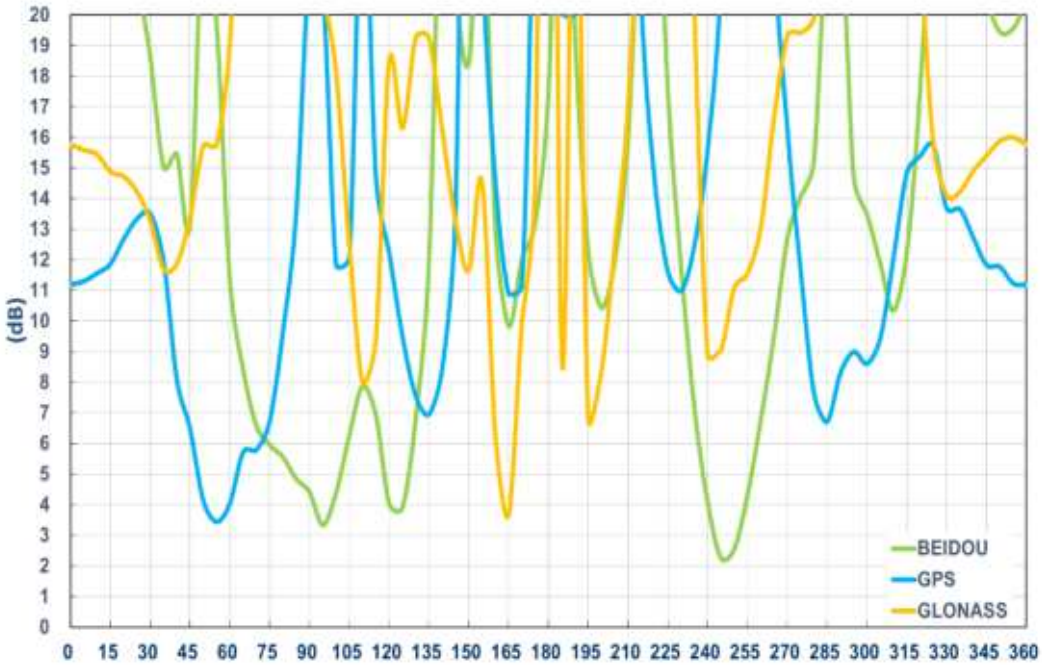


6.5 GNSS – Peak Gain (Passive)



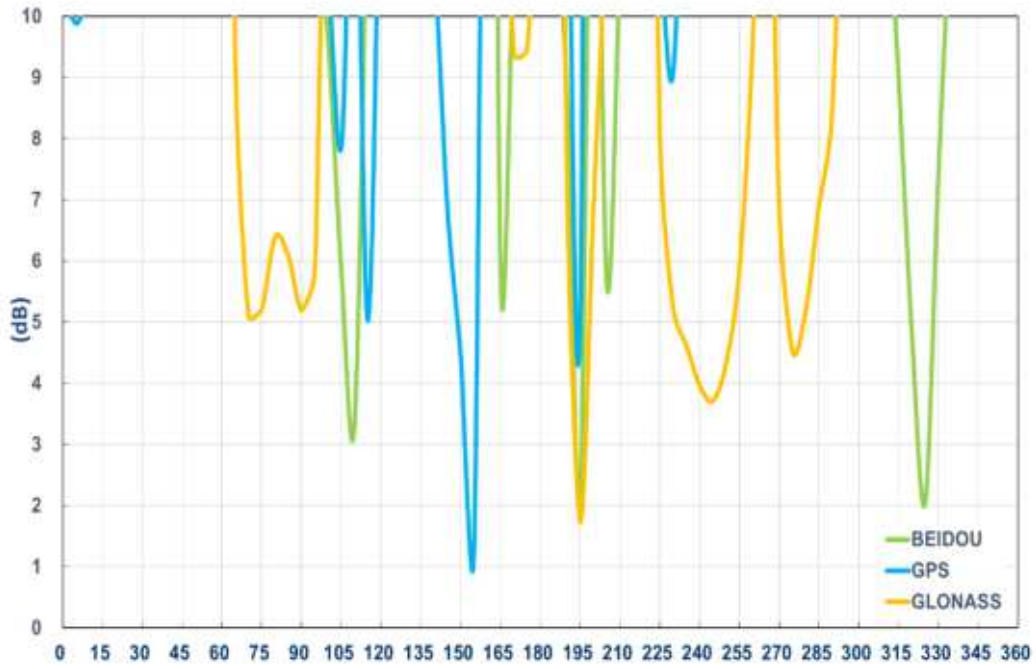
6.6 GNSS – Axial Ratio

XZ- Plane

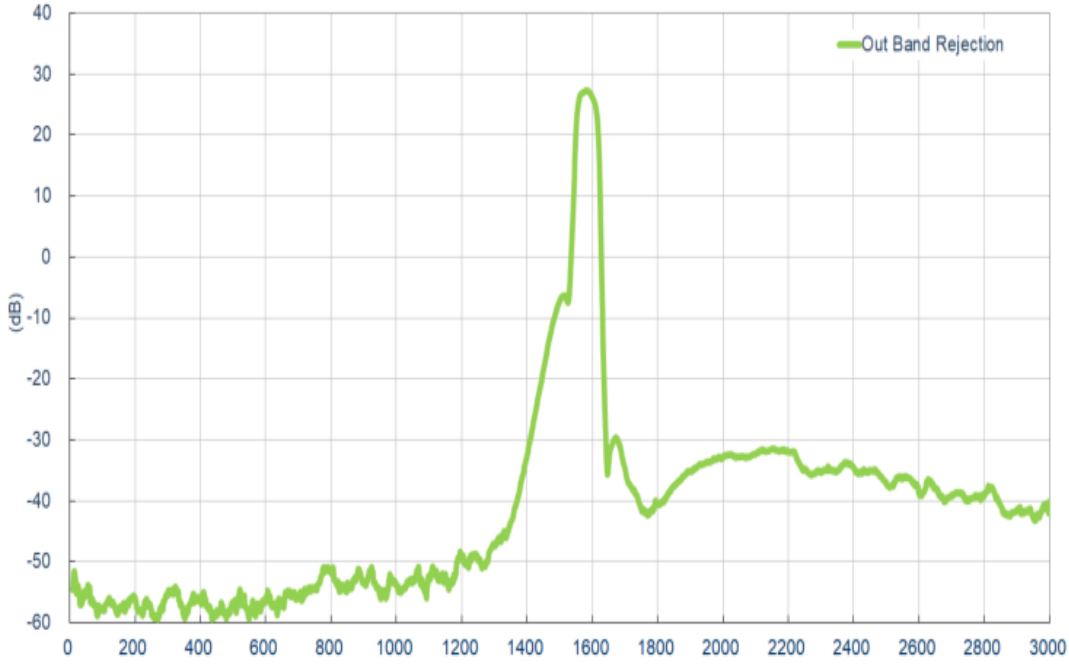


6.7 GNSS – Axial Ratio

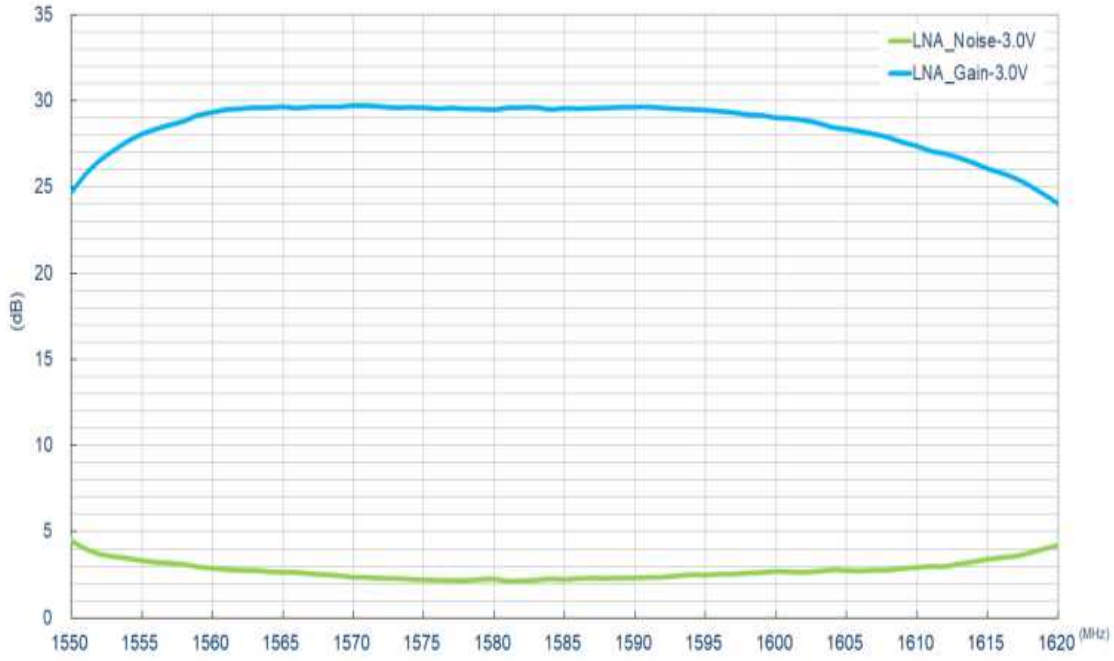
YZ- Plane



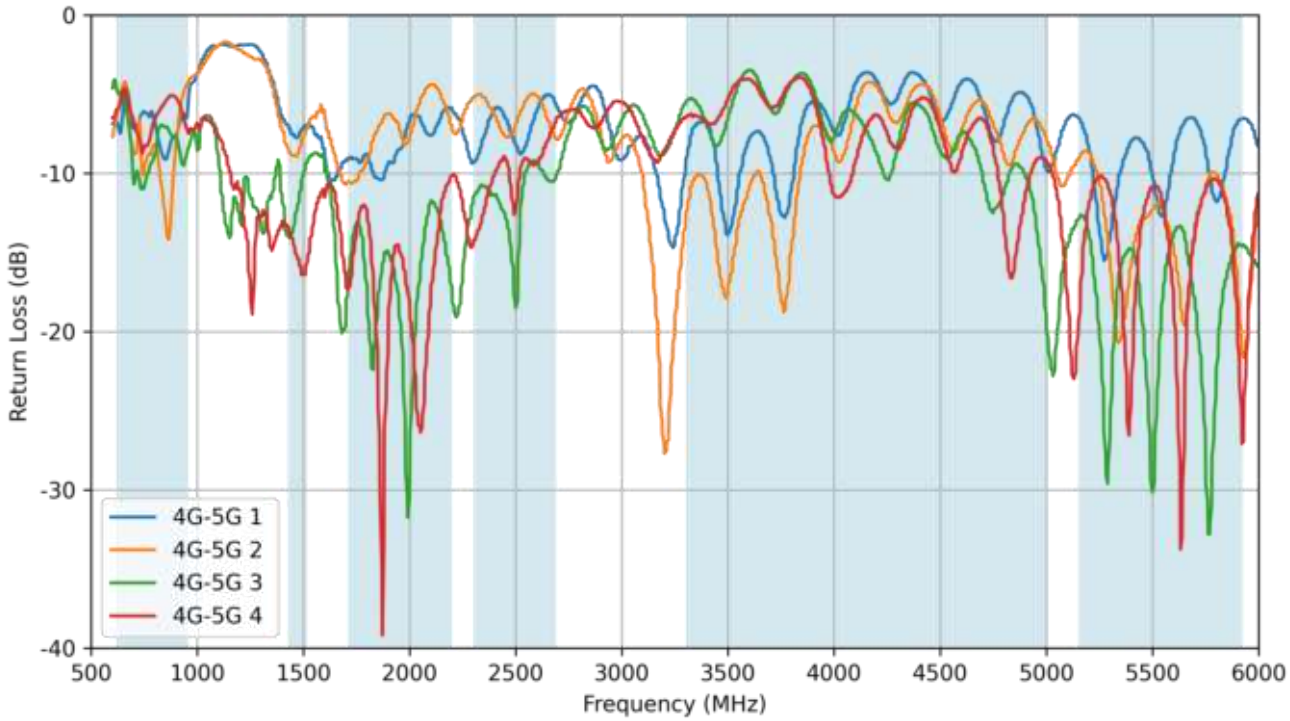
6.8 GNSS – LNA Gain @ 3.0V



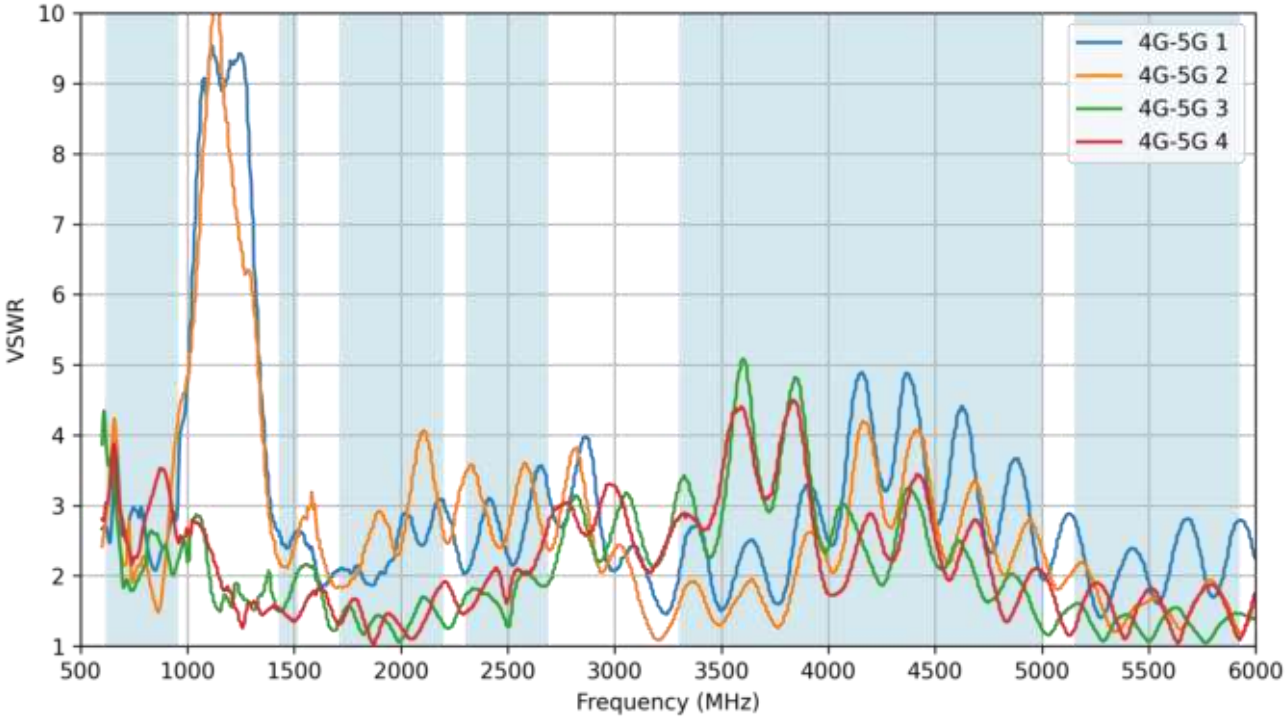
6.9 Noise Figure @ 3.0V



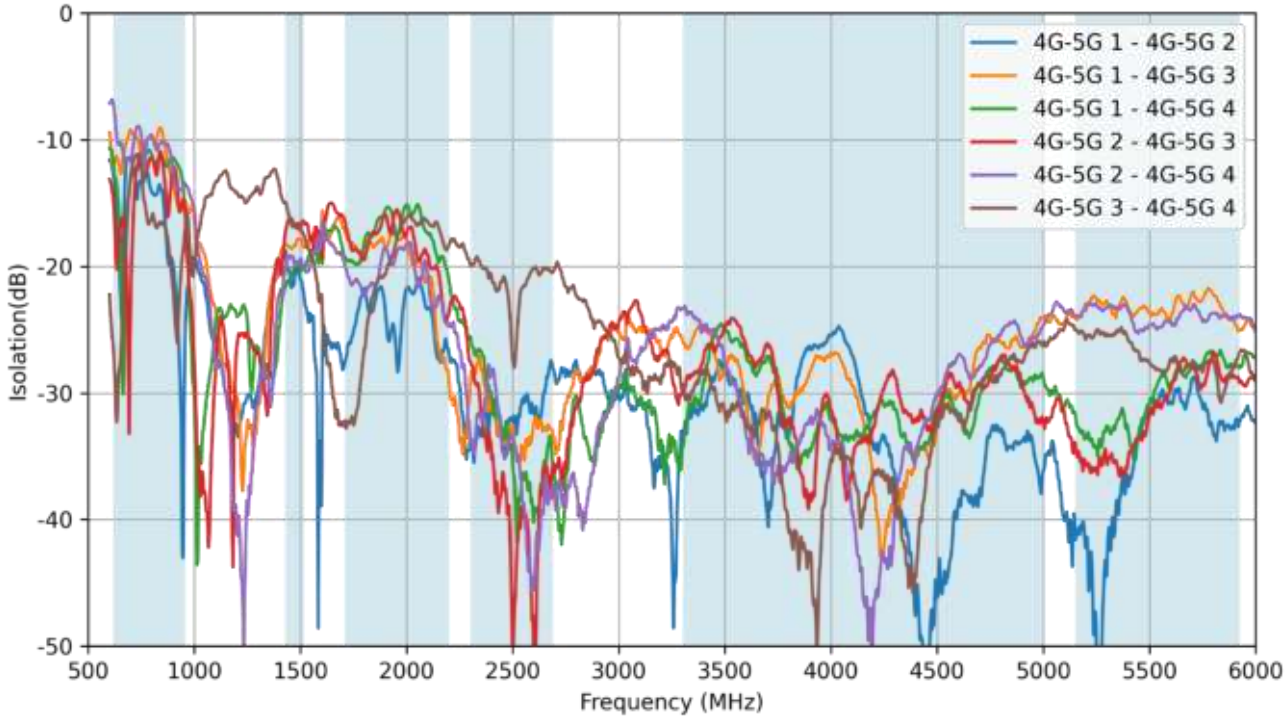
6.10 4G-5G - Return Loss



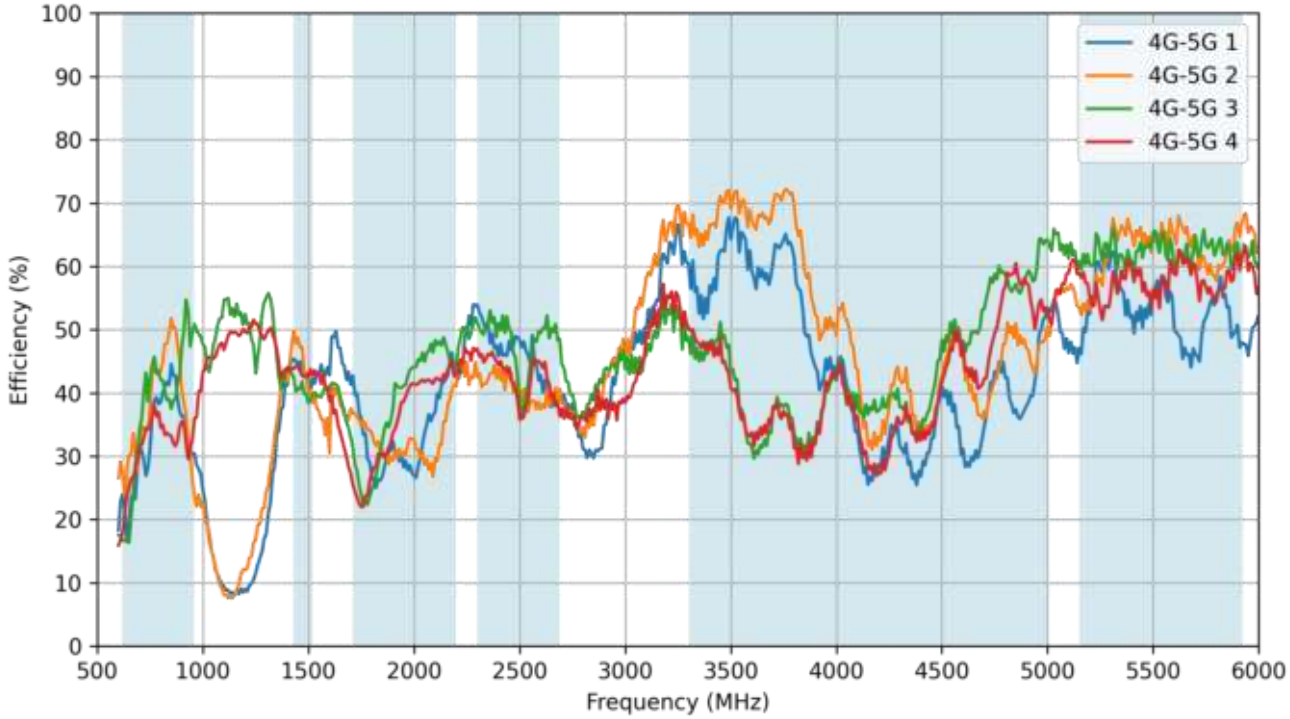
6.11 4G-5G - VSWR



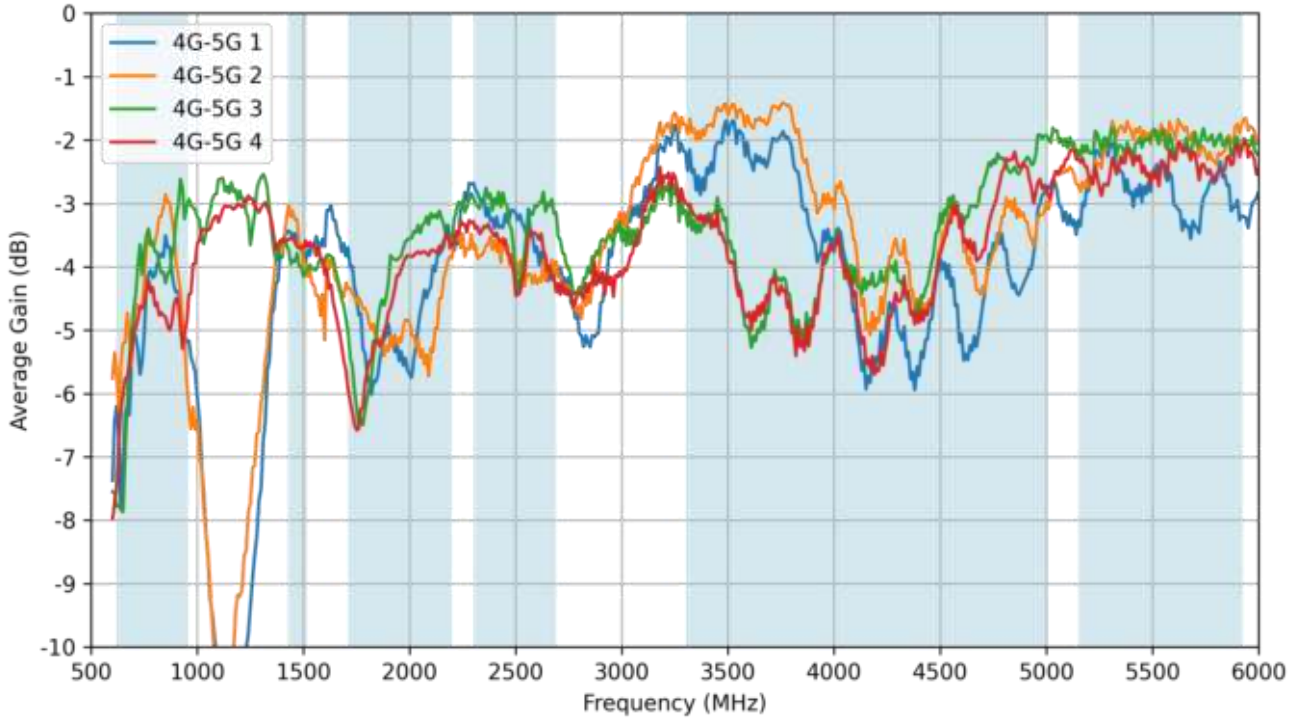
6.12 4G-5G - Isolation



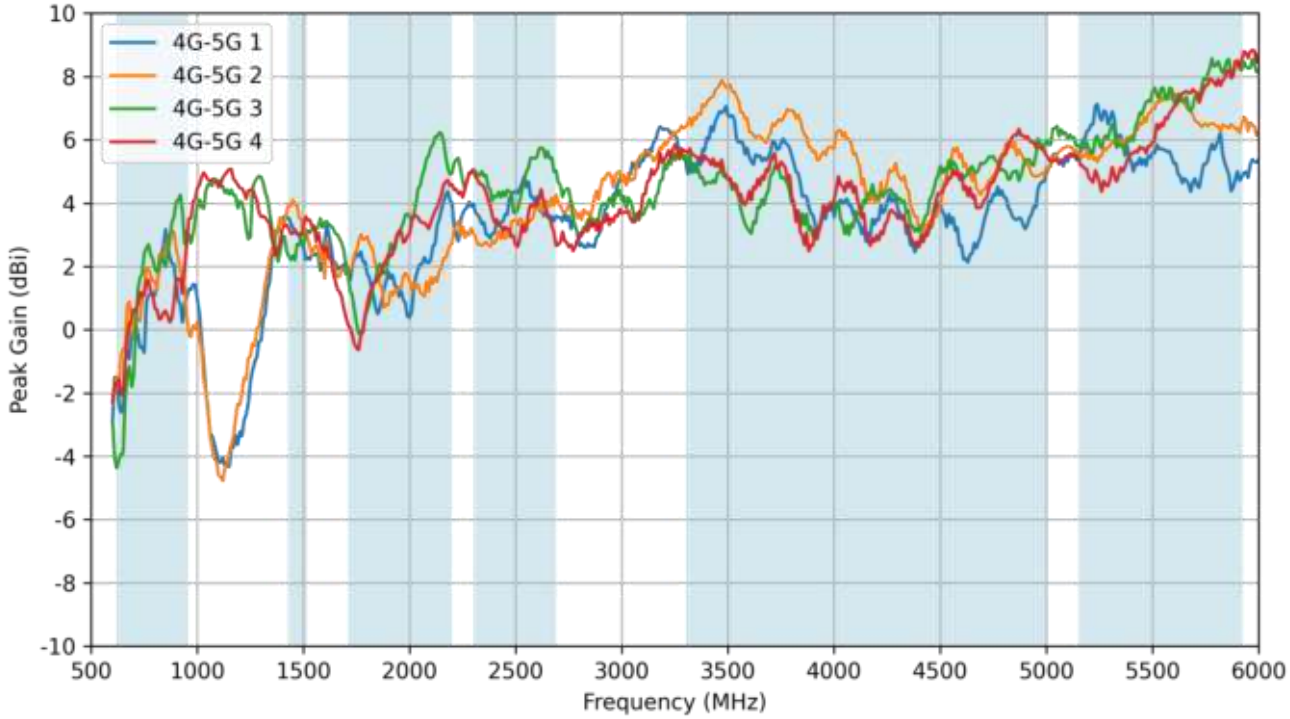
6.13 4G-5G - Efficiency



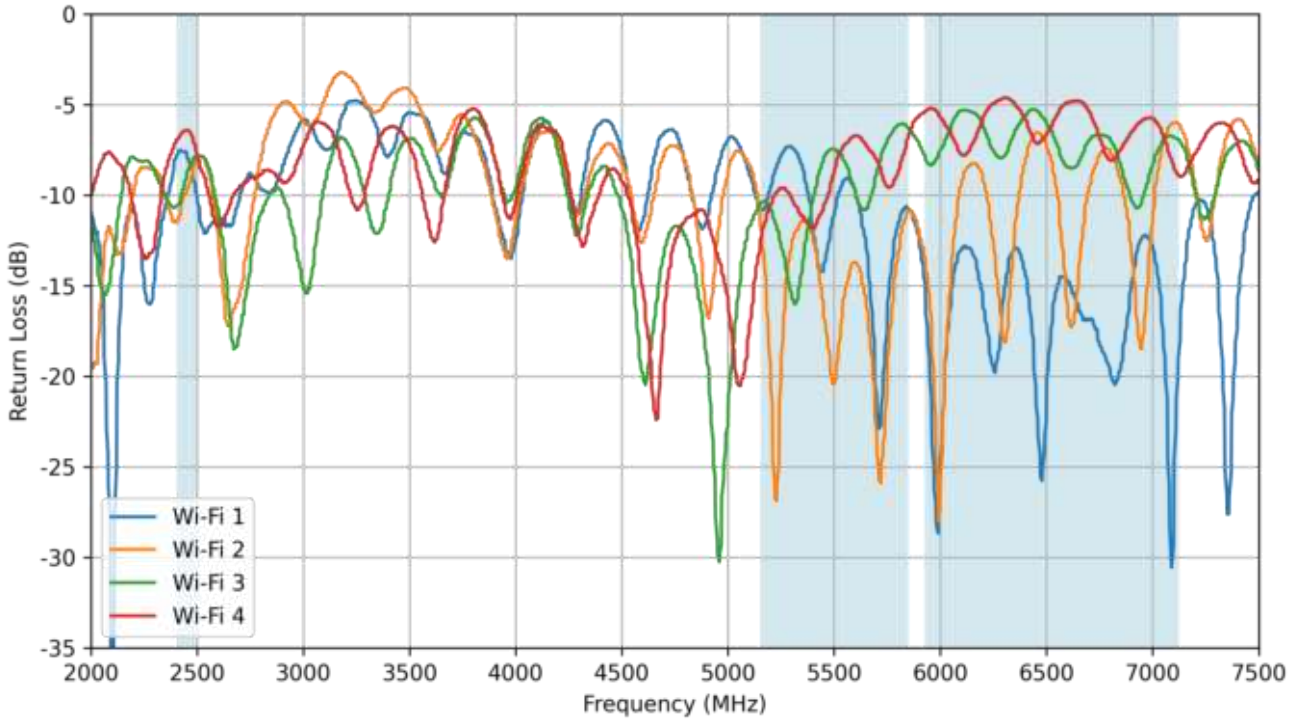
6.14 4G-5G - Average Gain



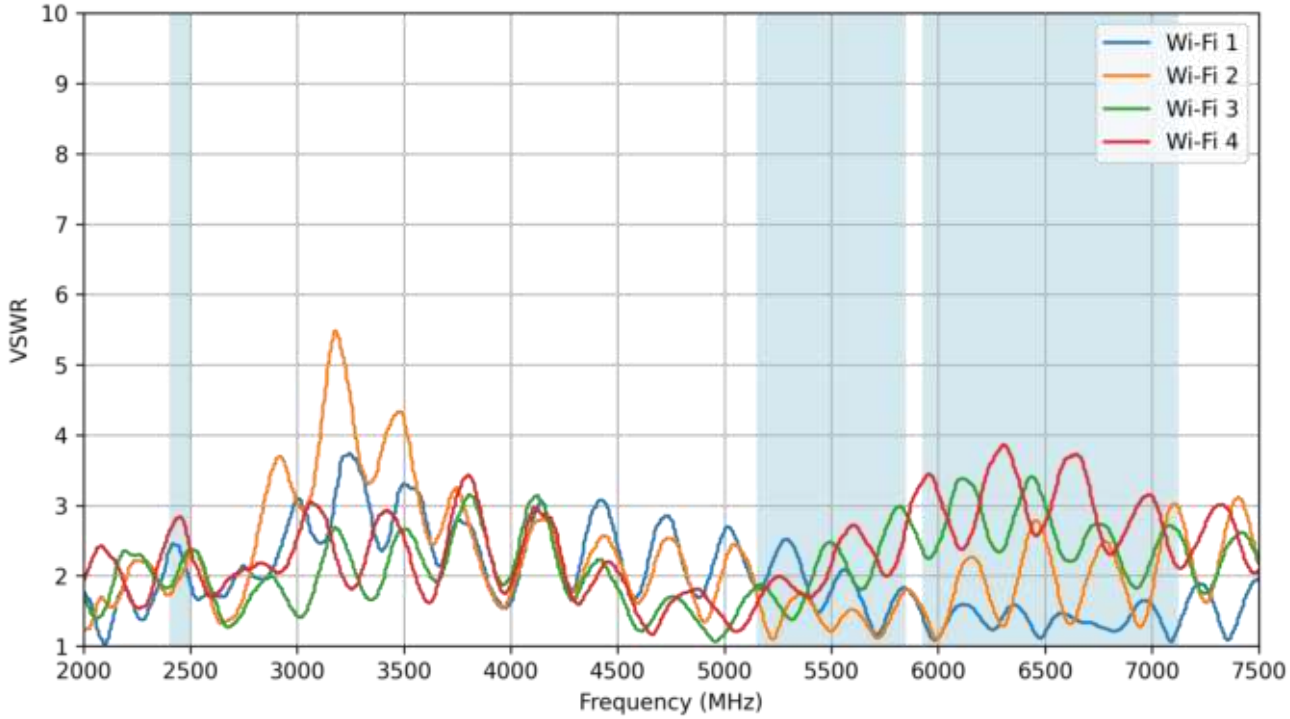
6.15 4G-5G - Peak Gain



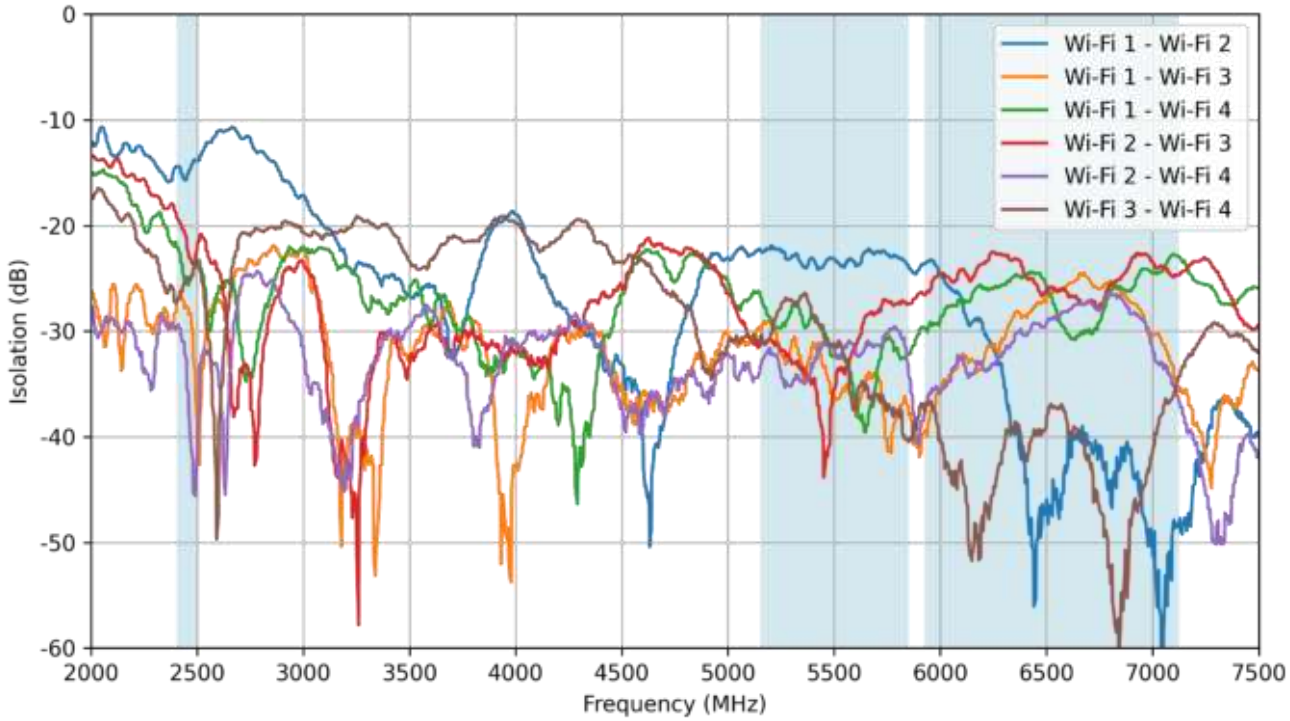
6.16 Wi-Fi - Return Loss



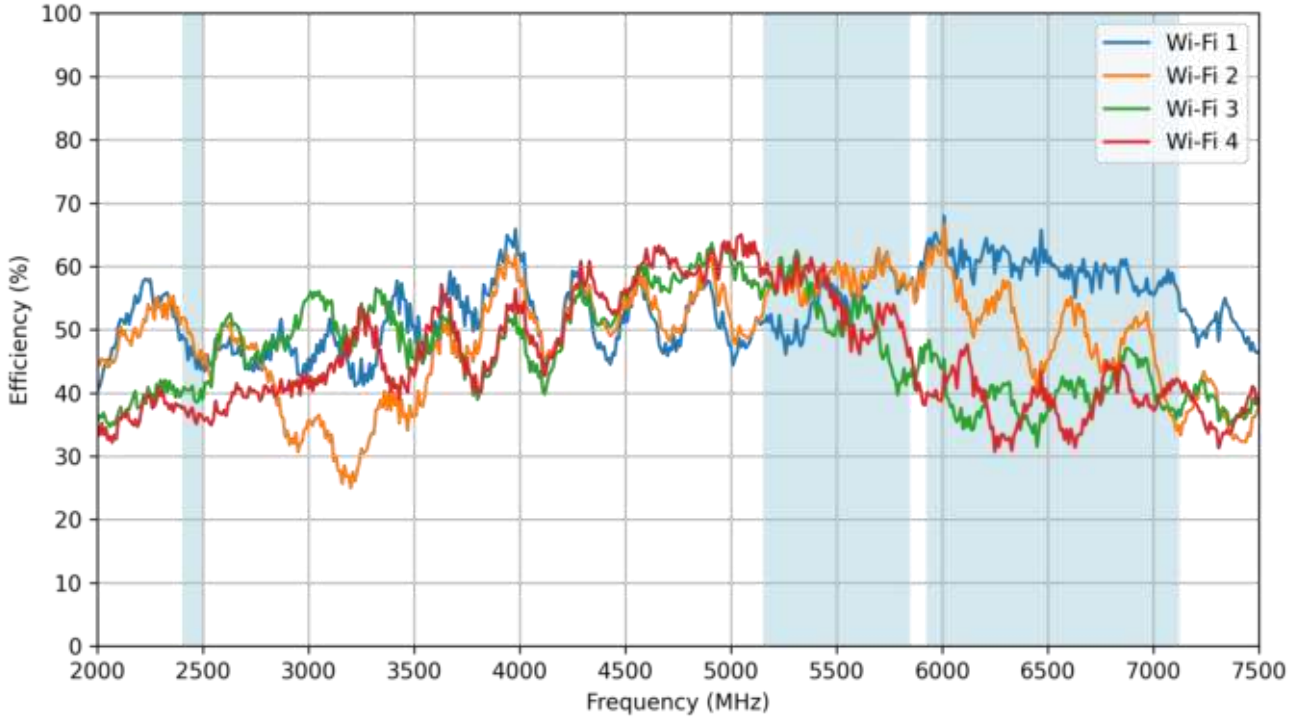
6.17 Wi-Fi - VSWR



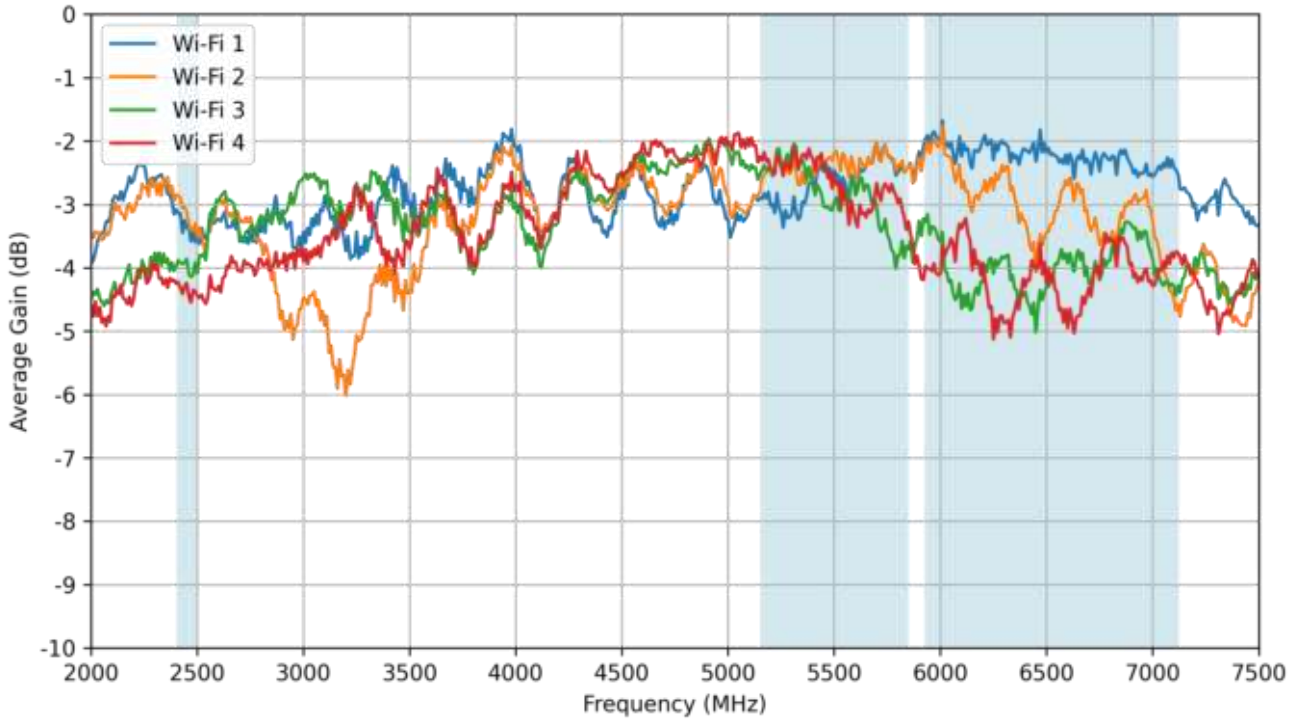
6.18 Wi-Fi - Isolation



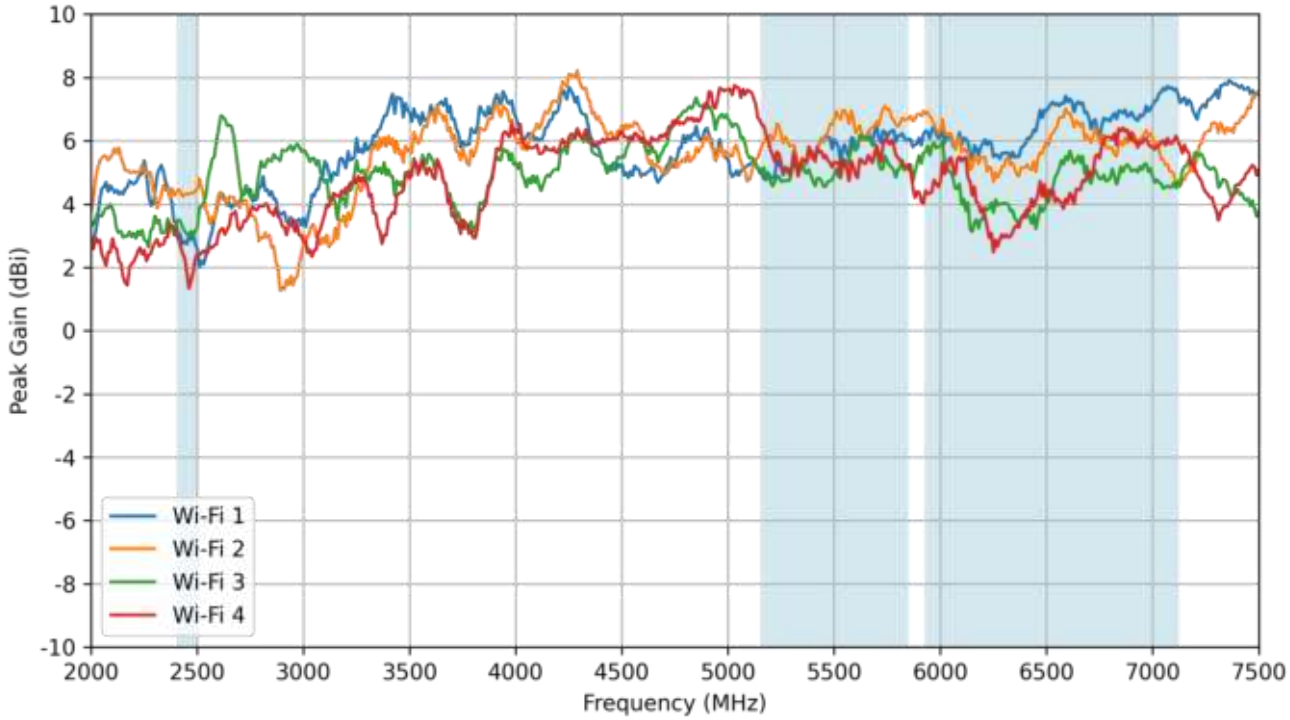
6.19 Wi-Fi - Efficiency



6.20 Wi-Fi - Average Gain

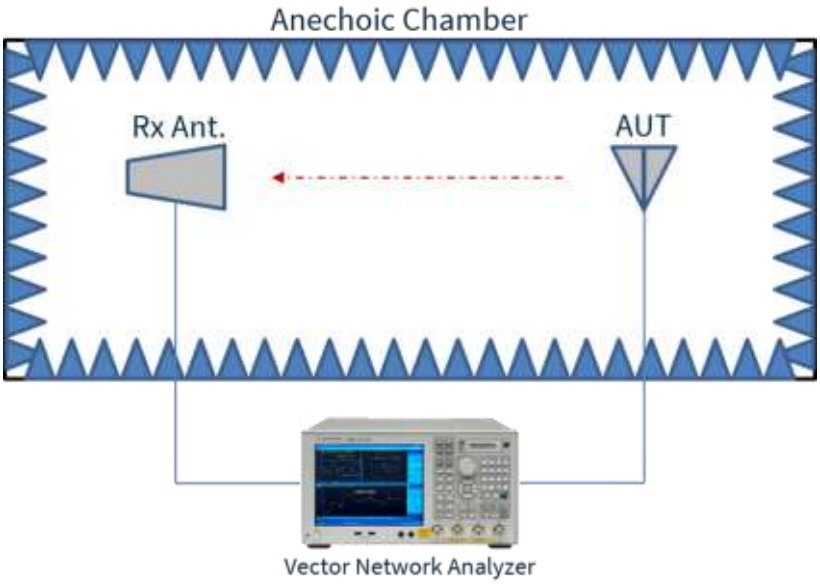


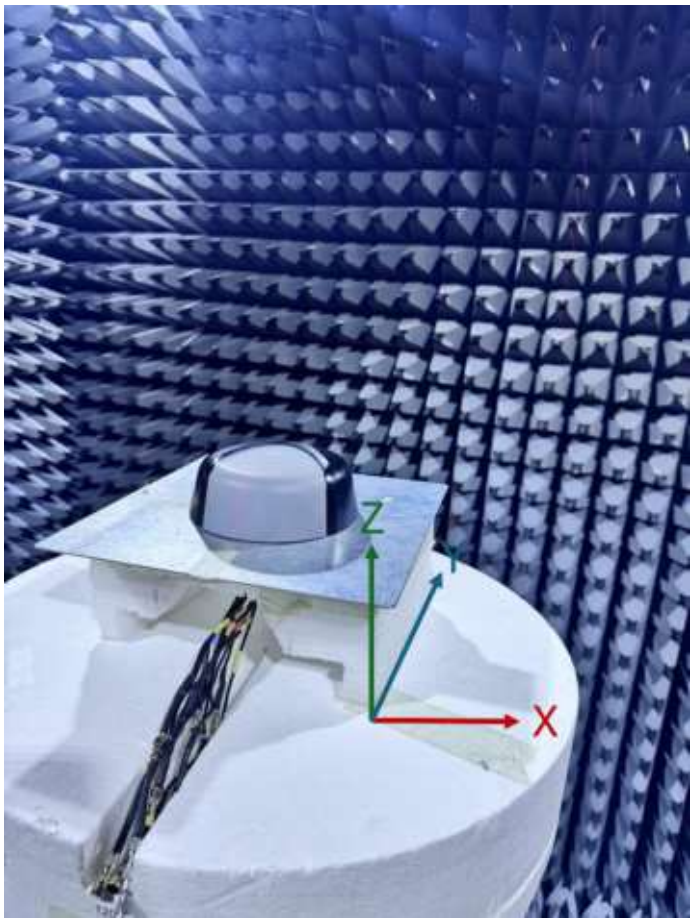
6.21 Wi-Fi - Peak Gain



7. Radiation Patterns

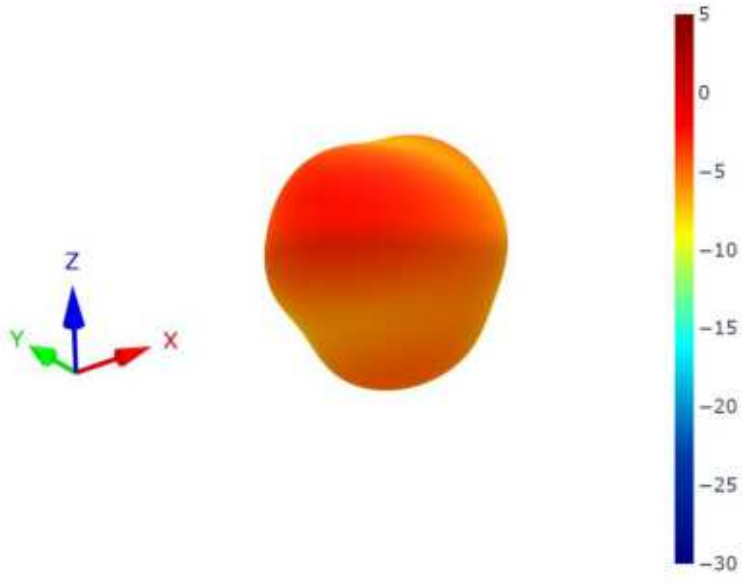
7.1 Test Setup

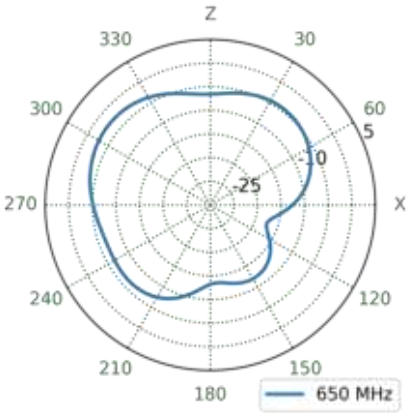
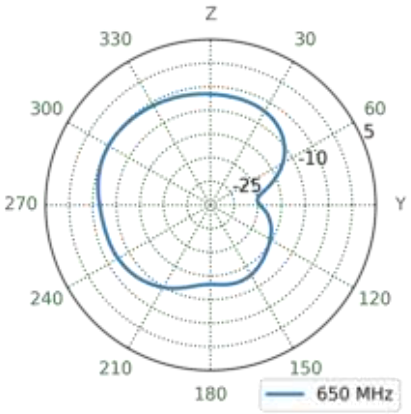
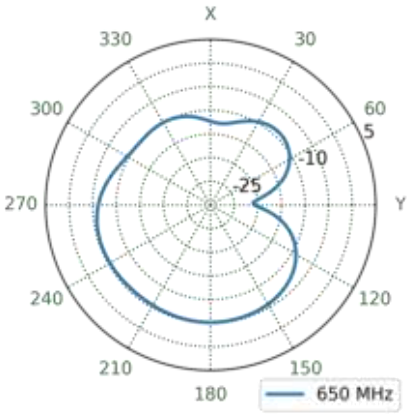




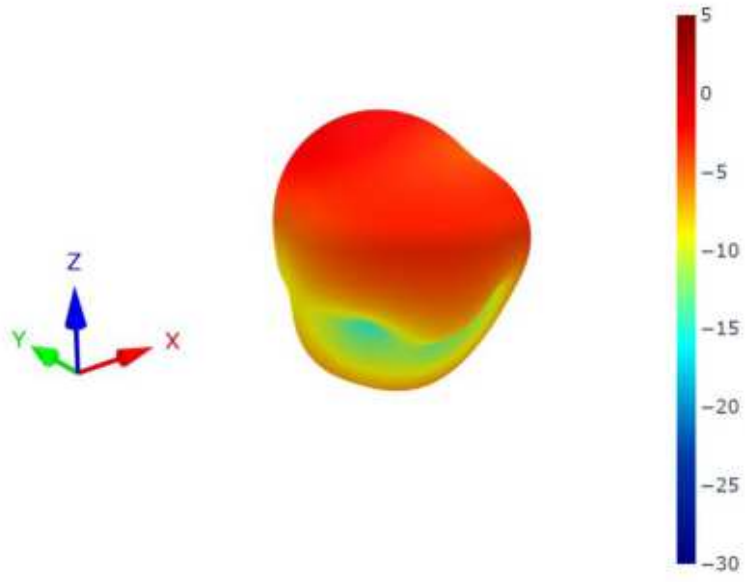
Chamber Test Set-up on a 30x30cm Ground Plane

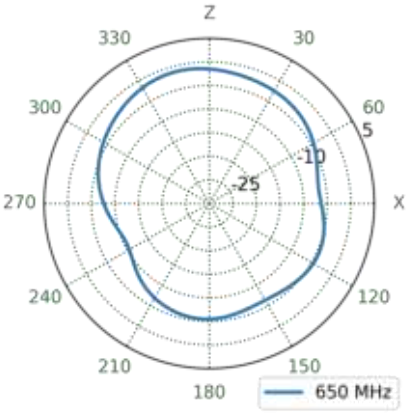
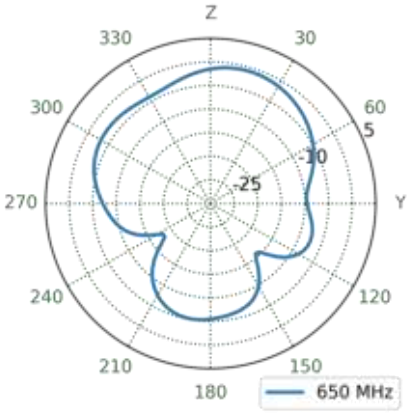
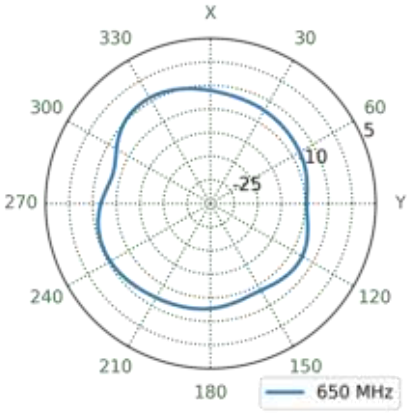
7.2 4G-5G 1 Patterns at 650 MHz



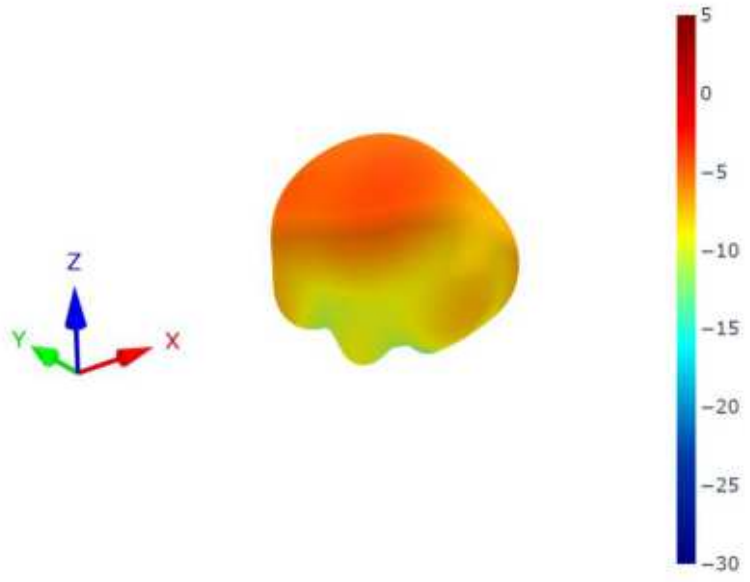
XZ Plane	YZ Plane	XY Plane
		

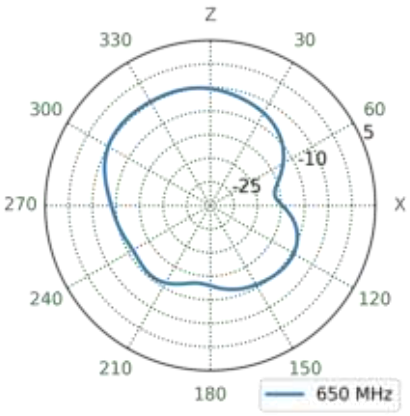
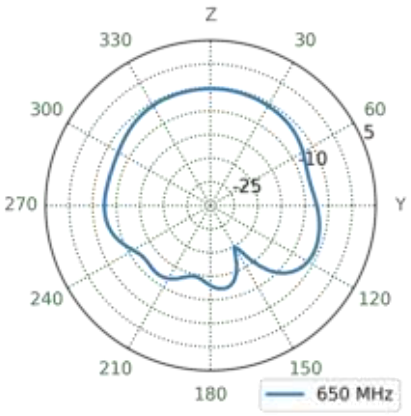
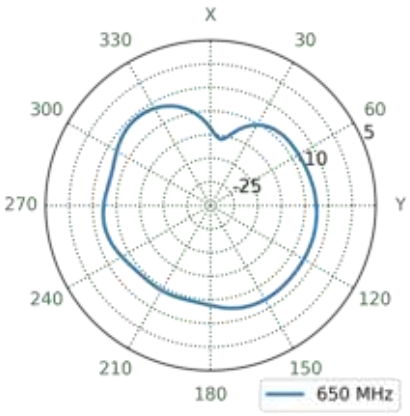
7.3 4G-5G 2 Patterns at 650 MHz



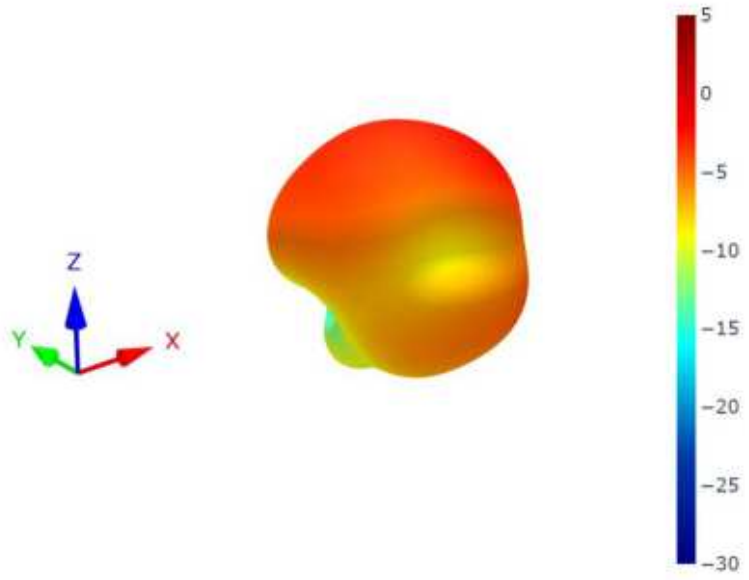
XZ Plane	YZ Plane	XY Plane
		

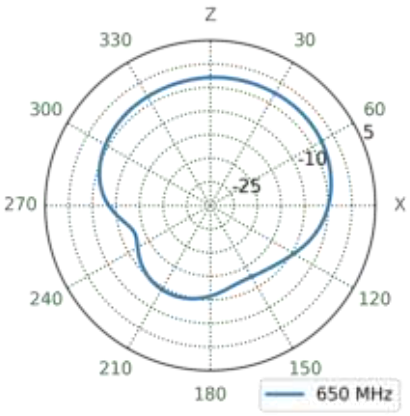
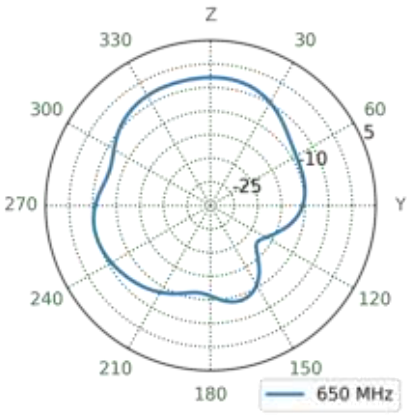
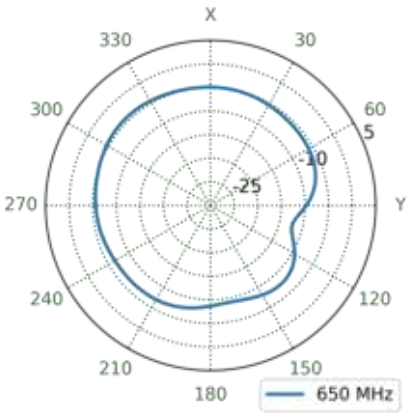
7.4 4G-5G 3 Patterns at 650 MHz



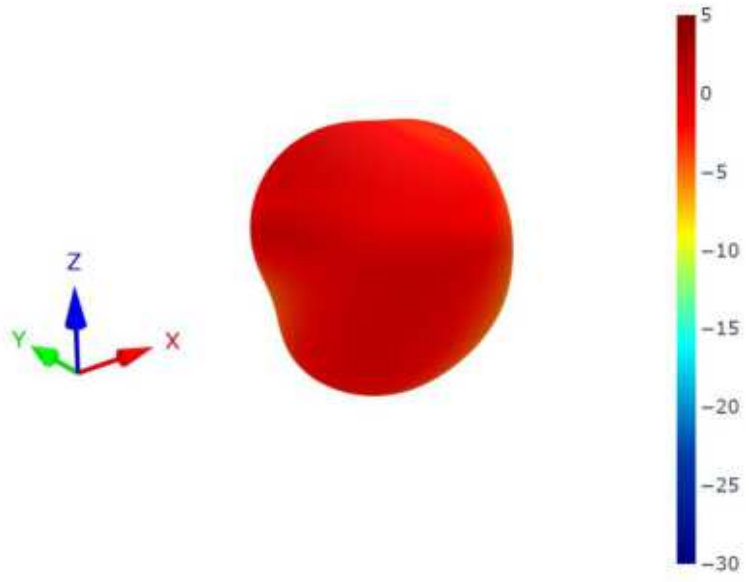
XZ Plane	YZ Plane	XY Plane
		

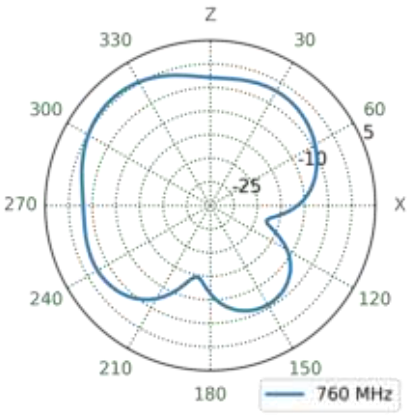
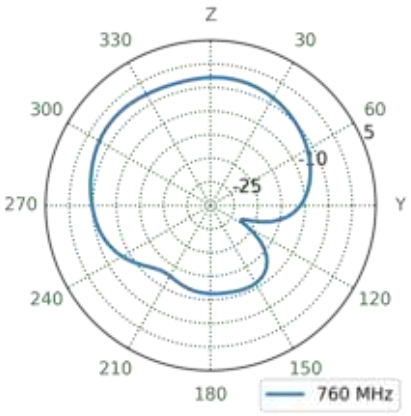
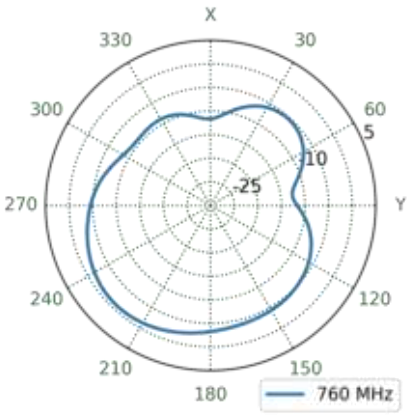
7.5 4G-5G 4 Patterns at 650 MHz



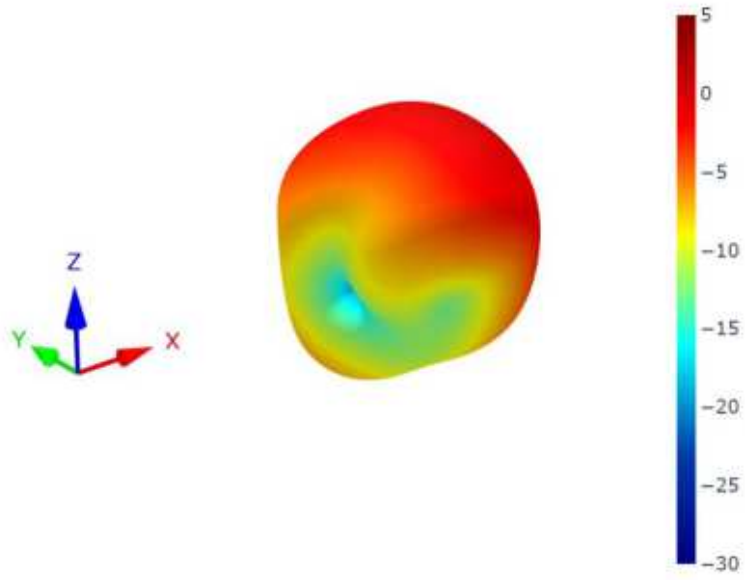
XZ Plane	YZ Plane	XY Plane
		

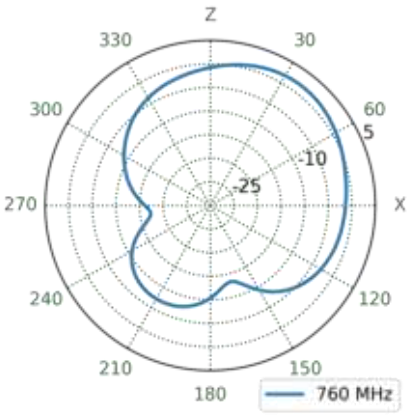
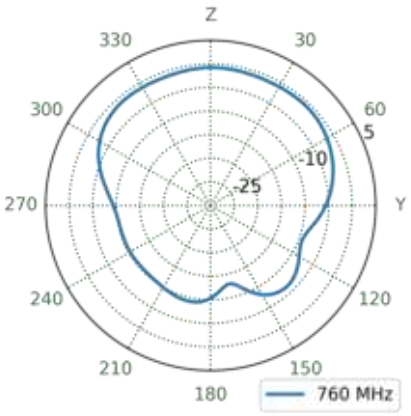
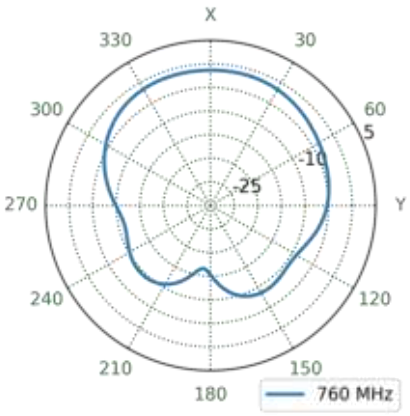
7.6 4G-5G 1 Patterns at 760 MHz



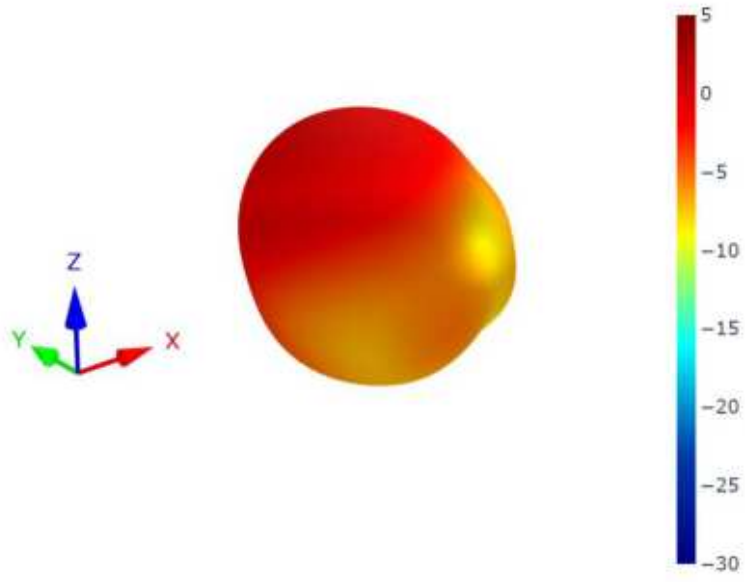
XZ Plane	YZ Plane	XY Plane
		

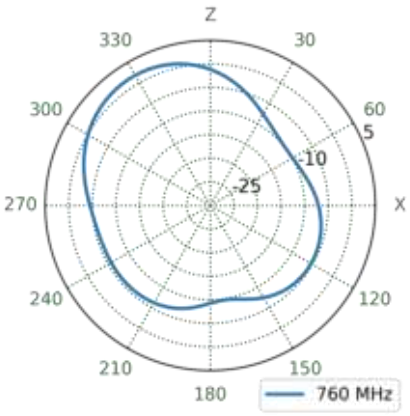
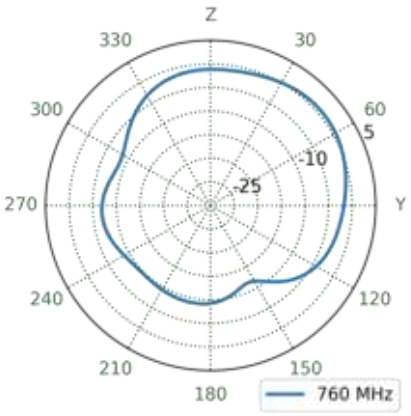
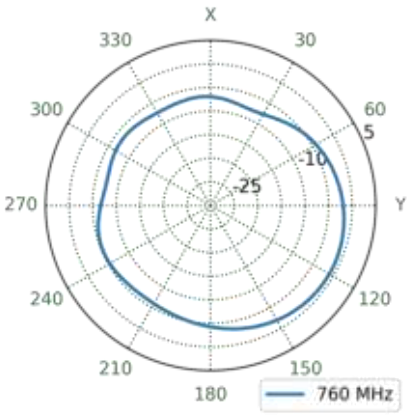
7.7 4G-5G 2 Patterns at 760 MHz



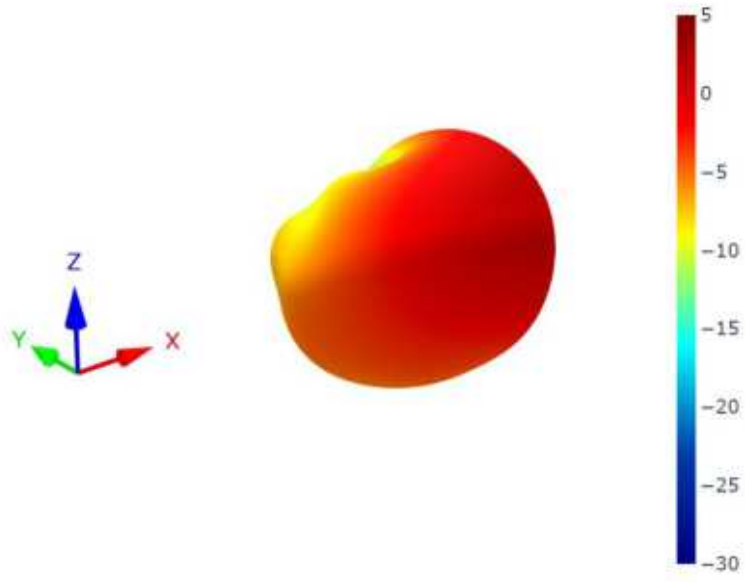
XZ Plane	YZ Plane	XY Plane
		

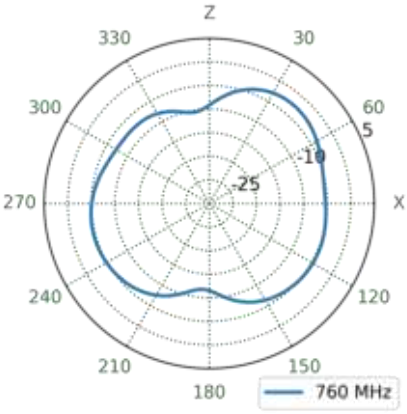
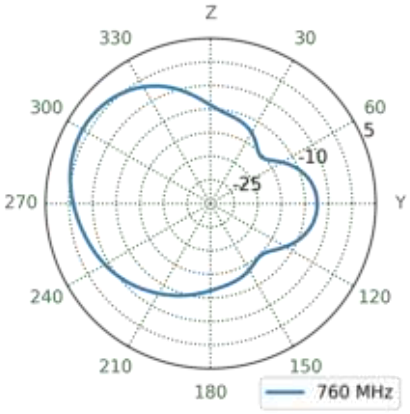
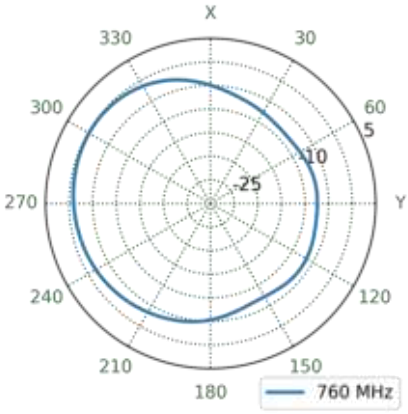
7.8 4G-5G 3 Patterns at 760 MHz



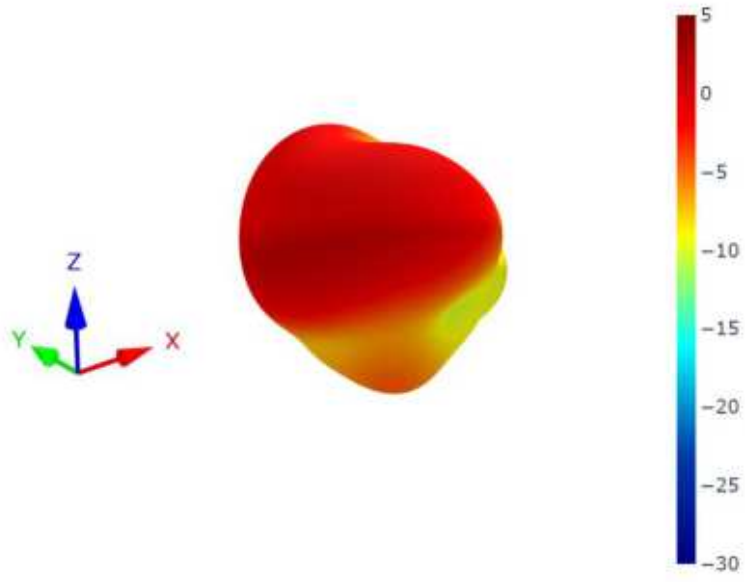
XZ Plane	YZ Plane	XY Plane
		

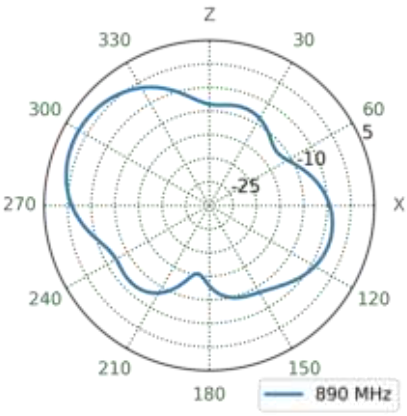
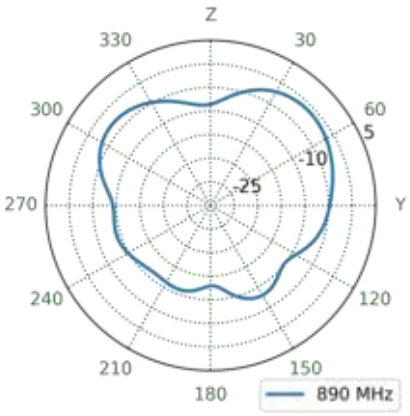
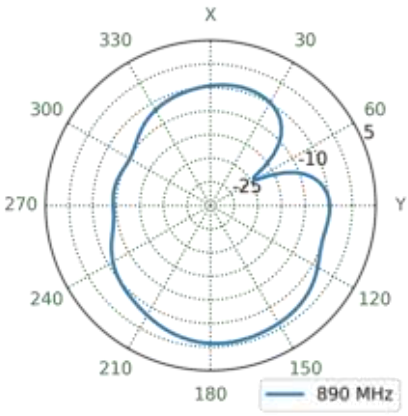
7.9 4G-5G 4 Patterns at 760 MHz



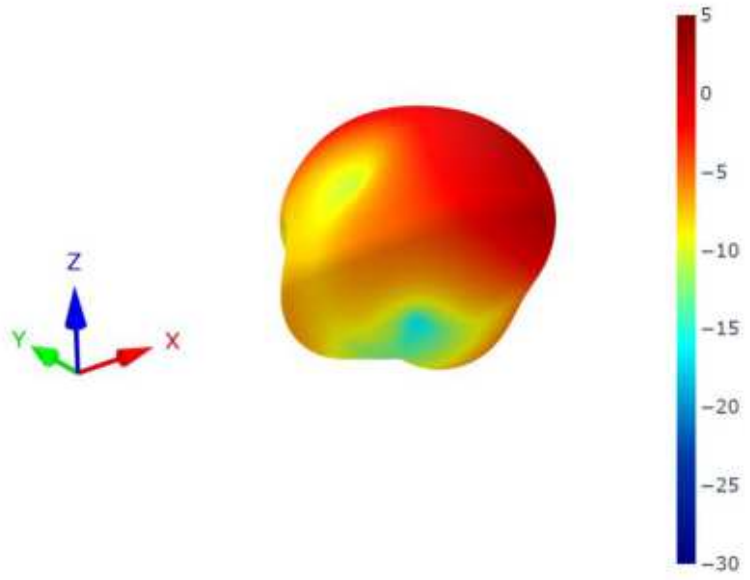
XZ Plane	YZ Plane	XY Plane
		

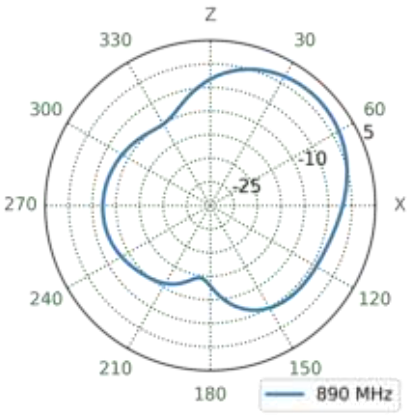
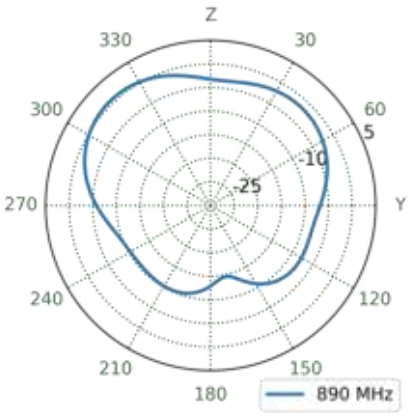
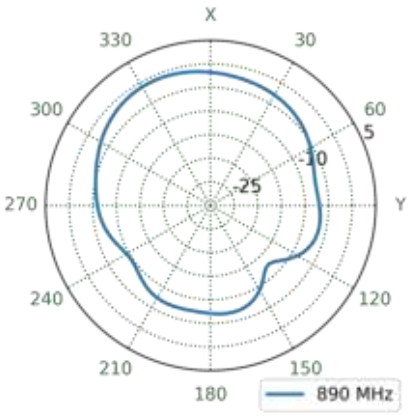
7.10 4G-5G 1 Patterns at 890 MHz



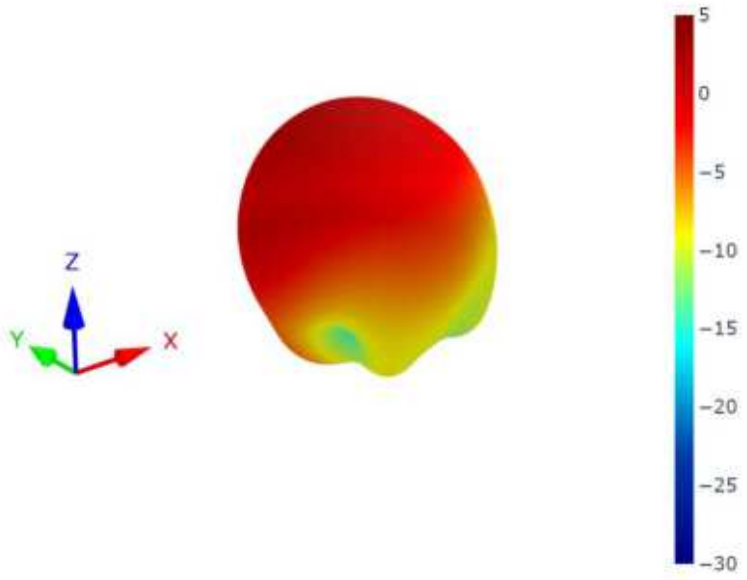
XZ Plane	YZ Plane	XY Plane
		

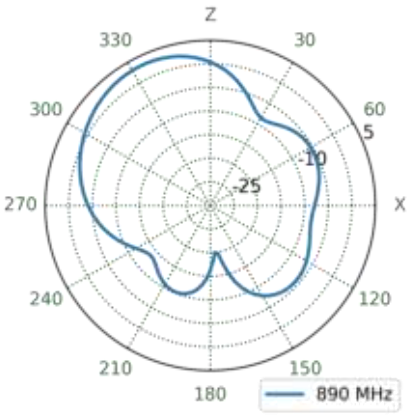
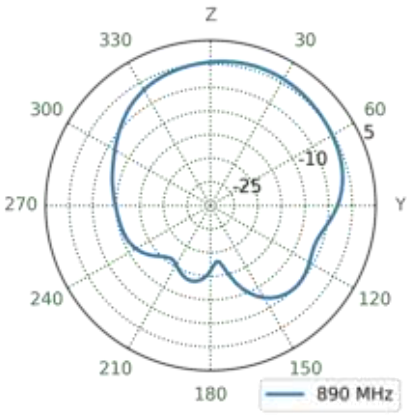
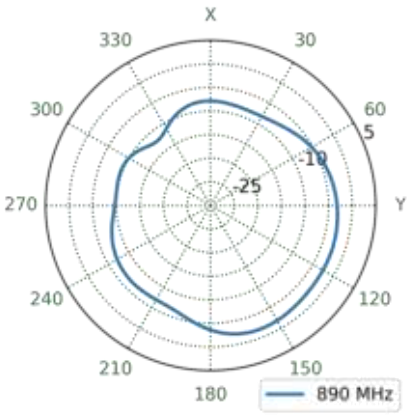
7.11 4G-5G 2 Patterns at 890 MHz



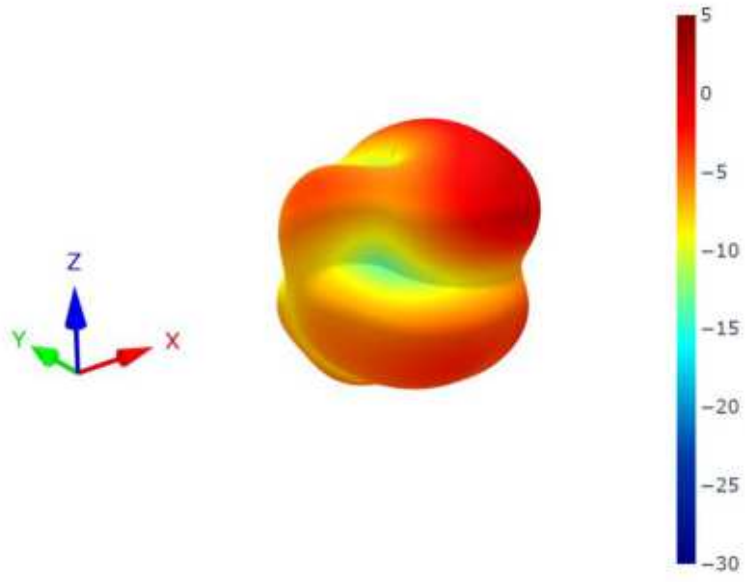
XZ Plane	YZ Plane	XY Plane
		

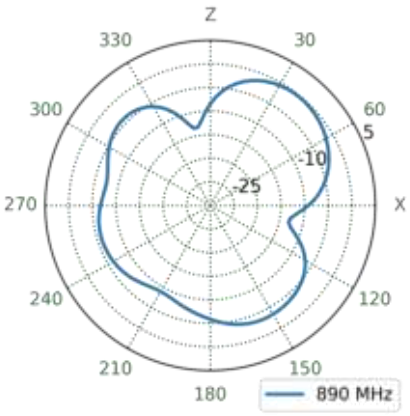
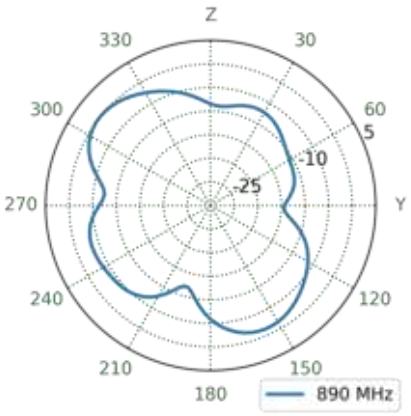
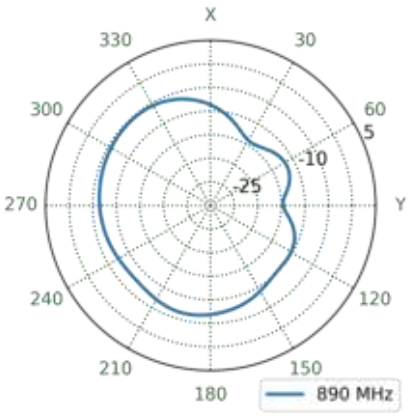
7.12 4G-5G 3 Patterns at 890 MHz



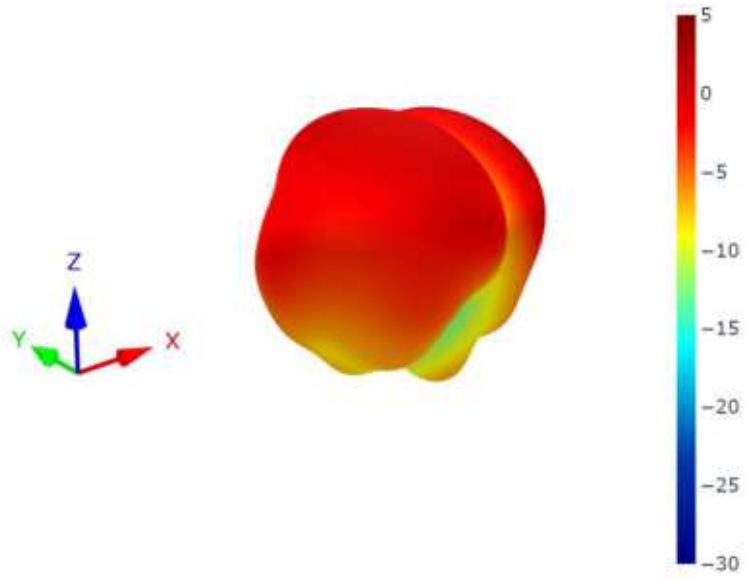
XZ Plane	YZ Plane	XY Plane
		

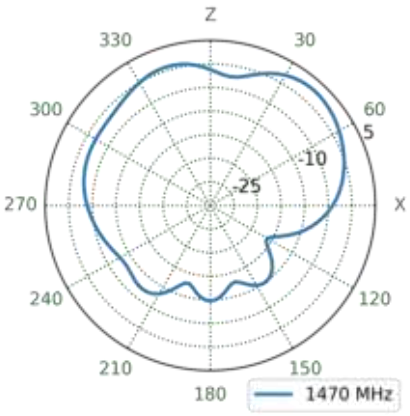
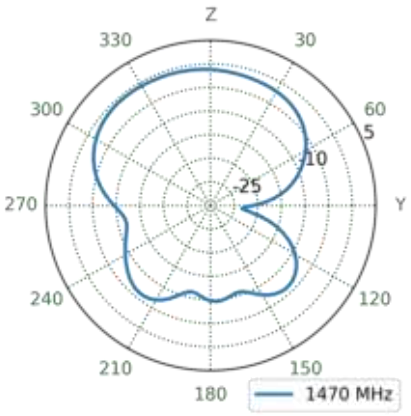
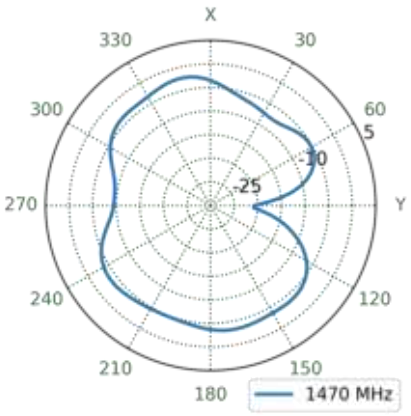
7.13 4G-5G 4 Patterns at 890 MHz



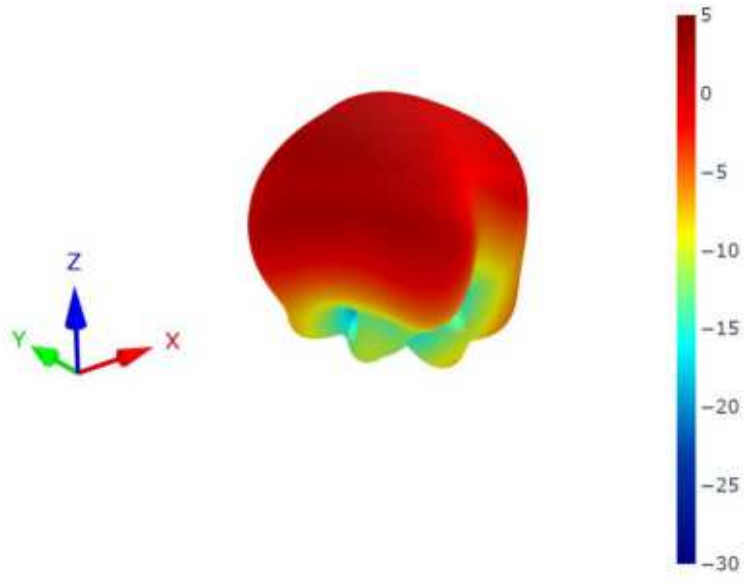
XZ Plane	YZ Plane	XY Plane
		

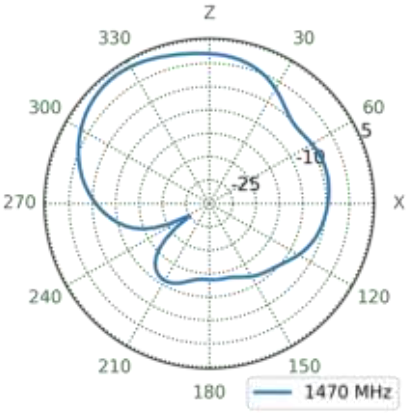
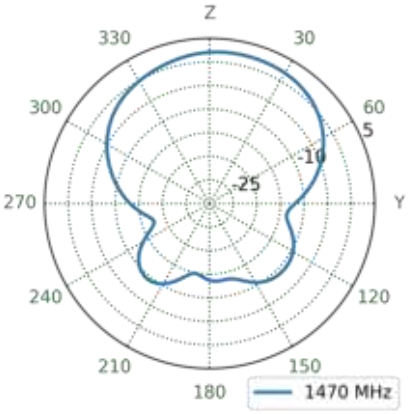
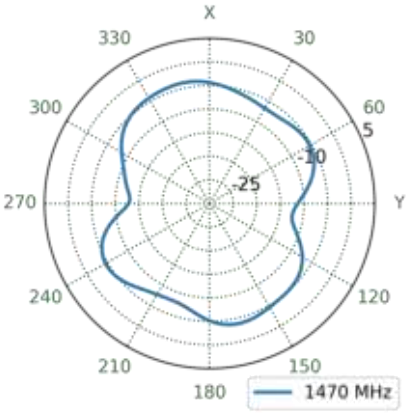
7.14 4G-5G 1 Patterns at 1470 MHz



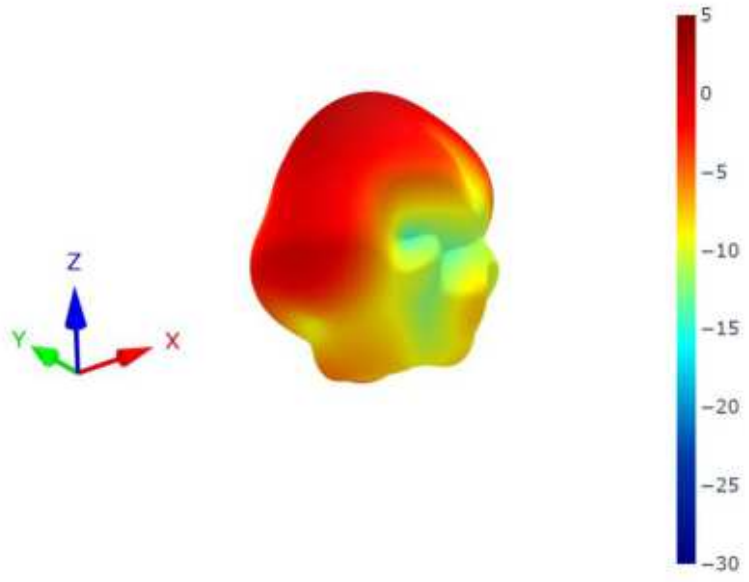
XZ Plane	YZ Plane	XY Plane
		

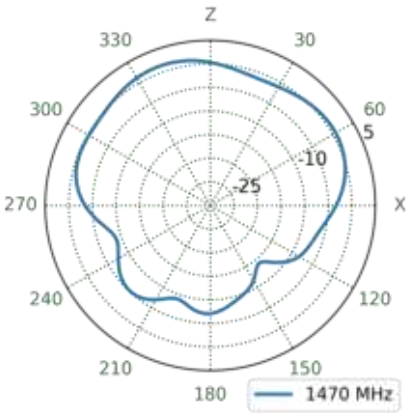
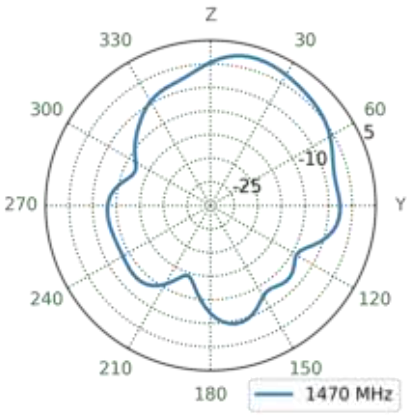
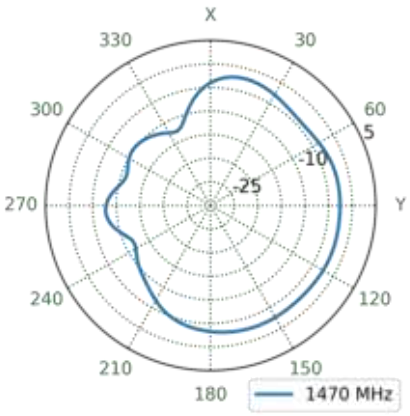
7.15 4G-5G 2 Patterns at 1470 MHz



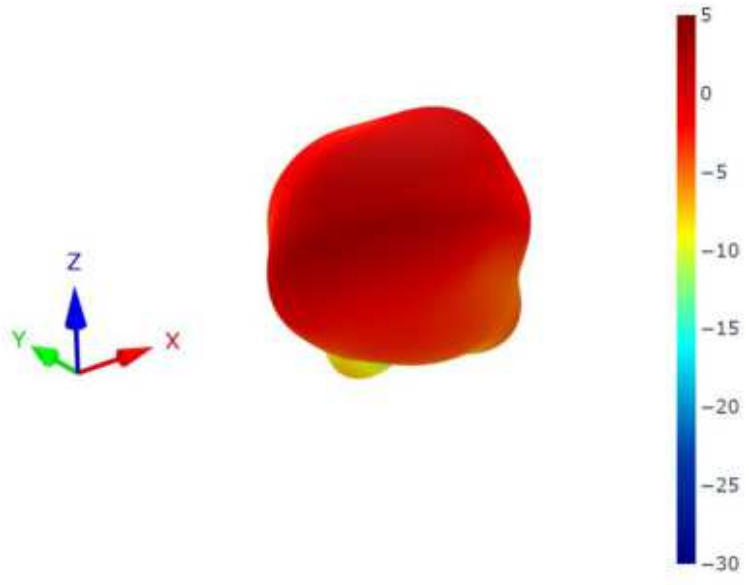
XZ Plane	YZ Plane	XY Plane
		

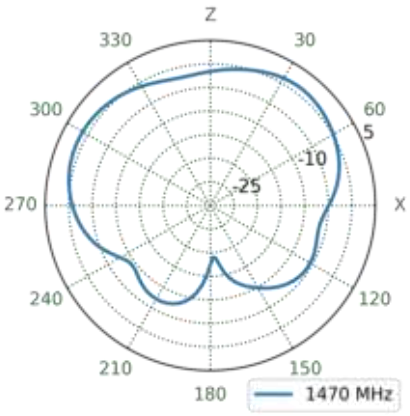
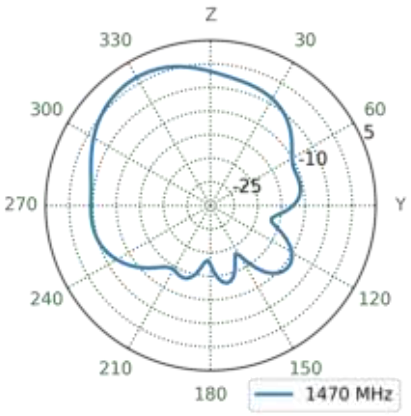
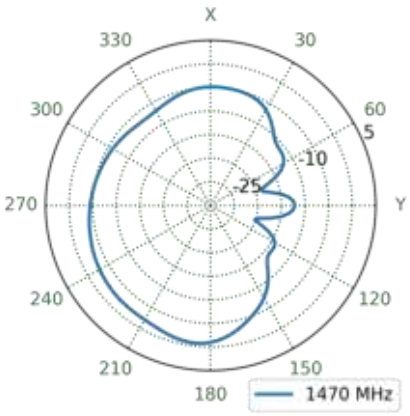
7.16 4G-5G 3 Patterns at 1470 MHz



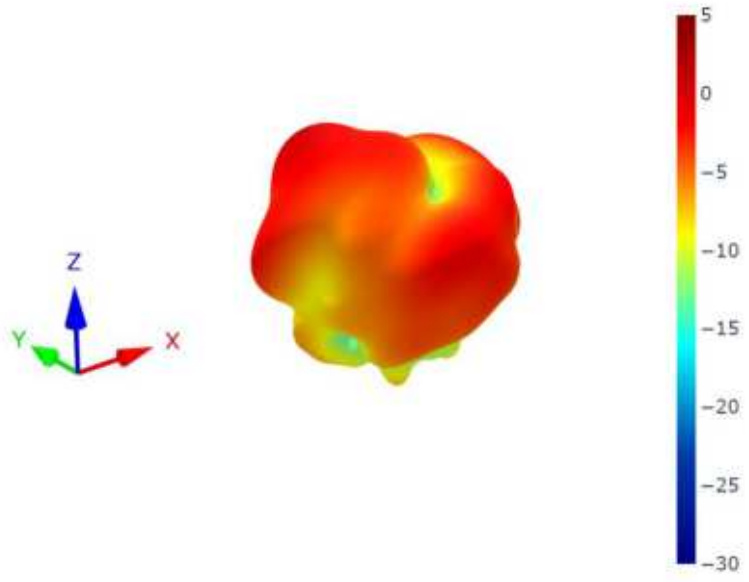
XZ Plane	YZ Plane	XY Plane
		

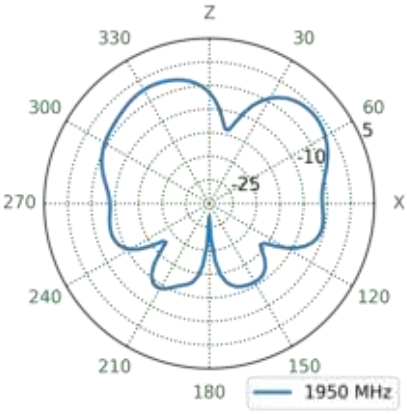
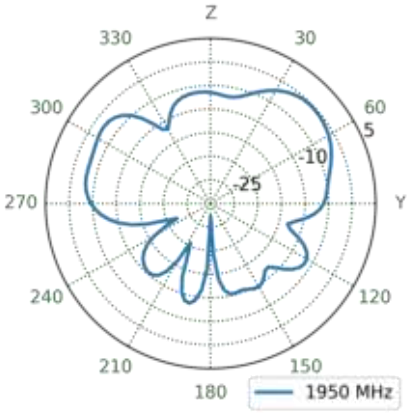
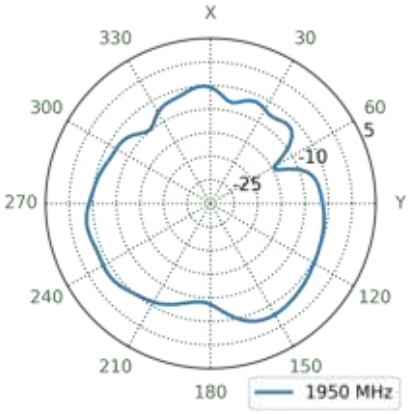
7.17 4G-5G 4 Patterns at 1470 MHz



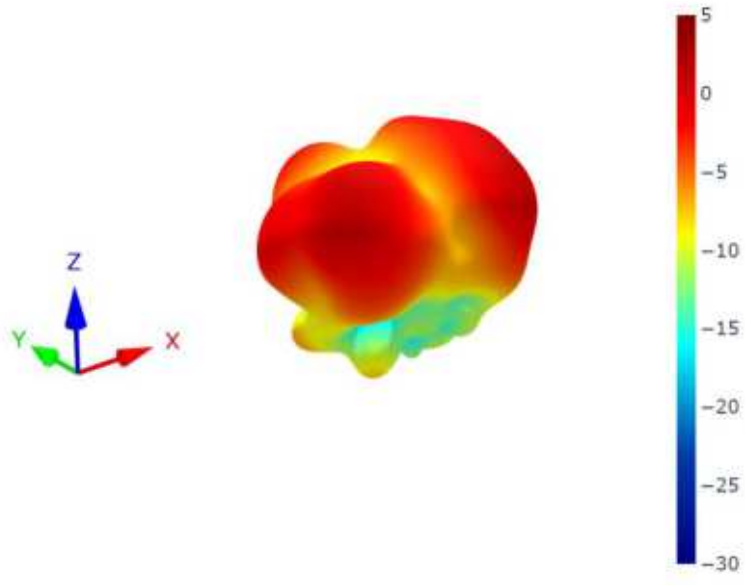
XZ Plane	YZ Plane	XY Plane
		

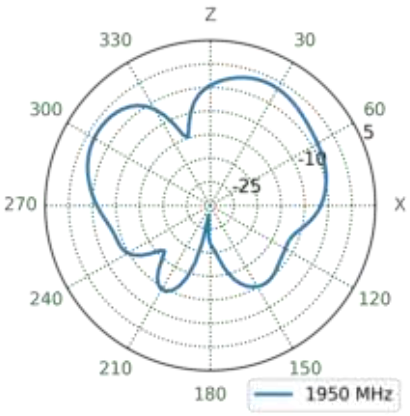
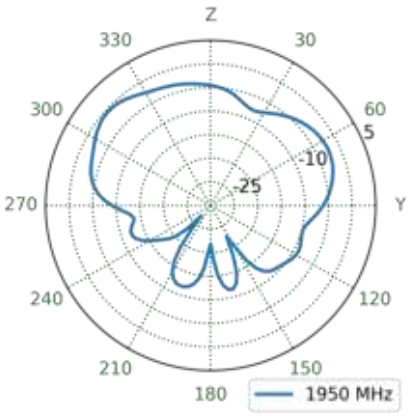
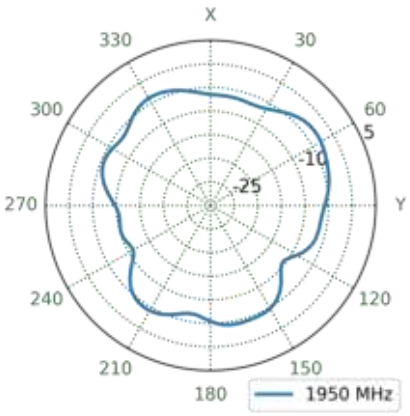
7.18 4G-5G 1 Patterns at 1950 MHz



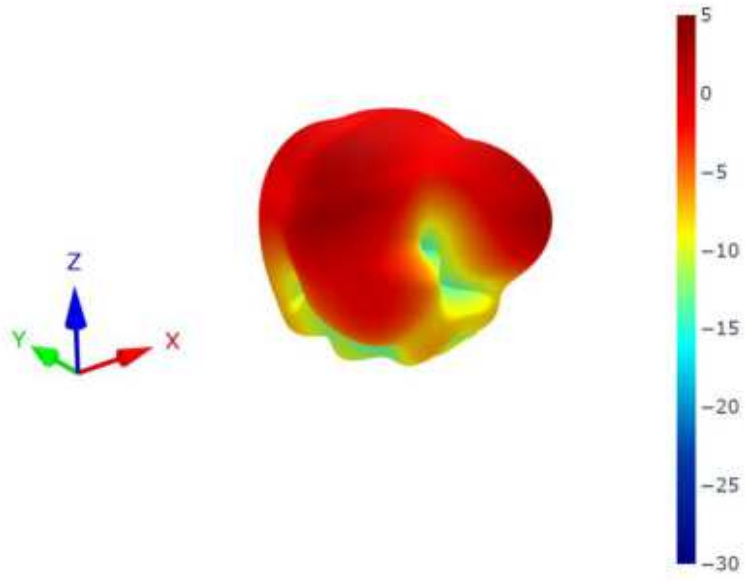
XZ Plane	YZ Plane	XY Plane
		

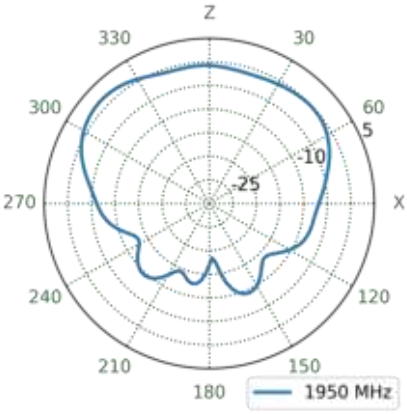
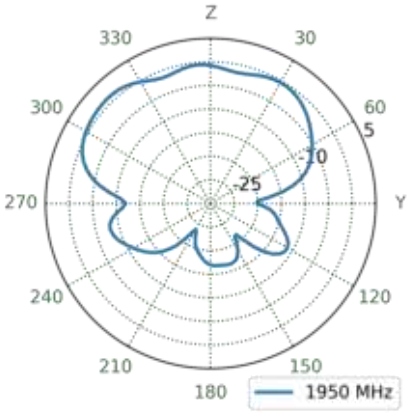
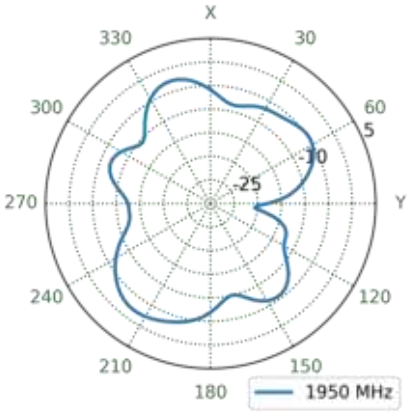
7.19 4G-5G 2 Patterns at 1950 MHz



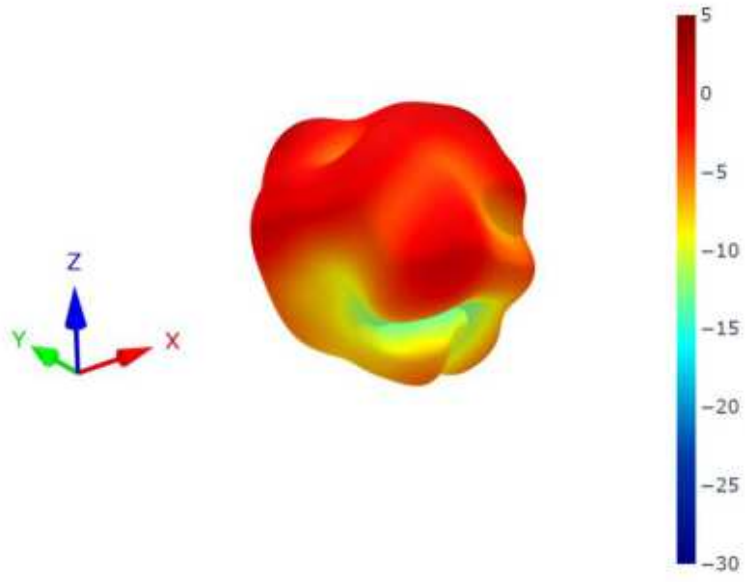
XZ Plane	YZ Plane	XY Plane
		

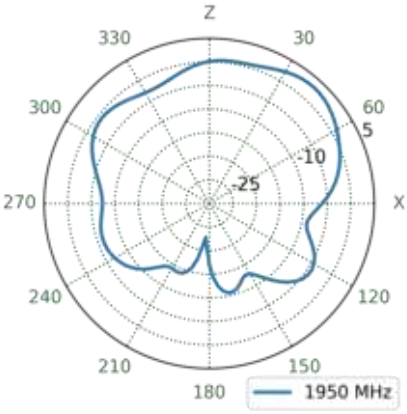
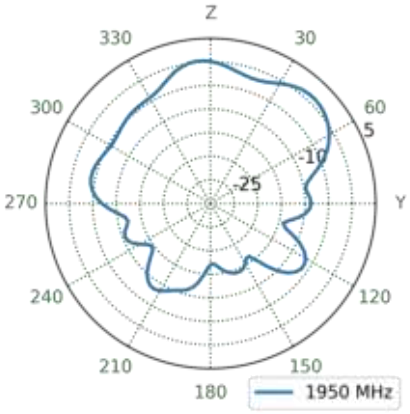
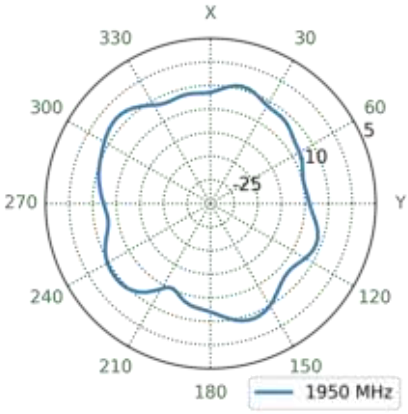
7.20 4G-5G 3 Patterns at 1950 MHz



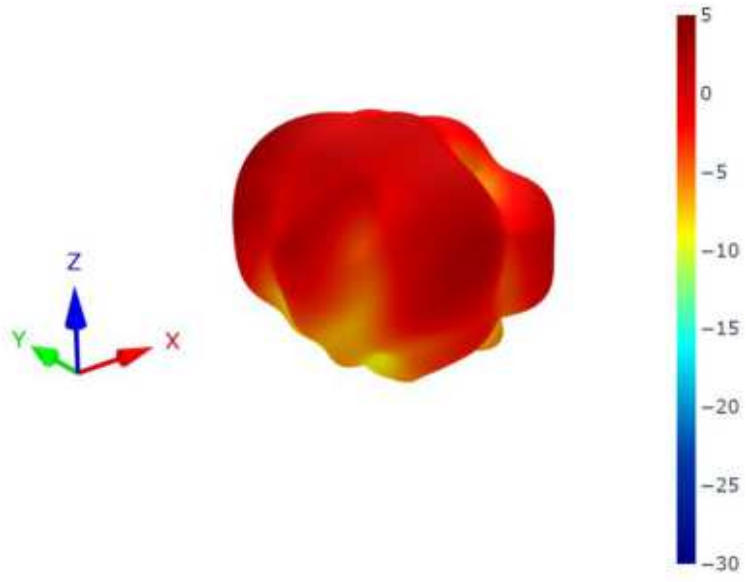
XZ Plane	YZ Plane	XY Plane
		

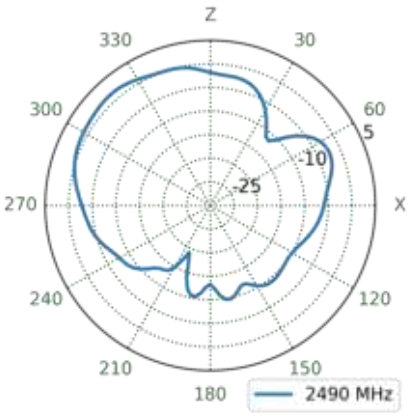
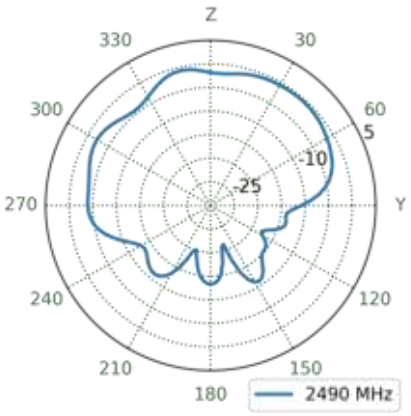
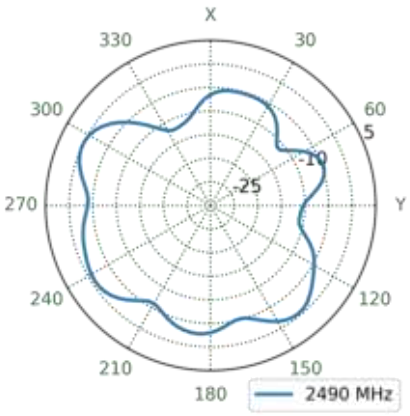
7.21 4G-5G 4 Patterns at 1950 MHz



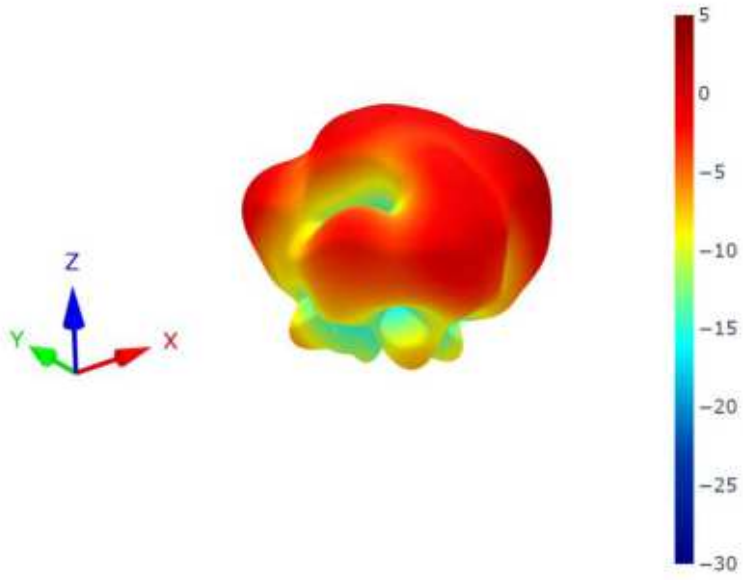
XZ Plane	YZ Plane	XY Plane
		

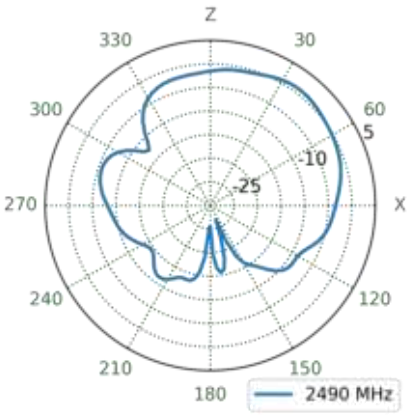
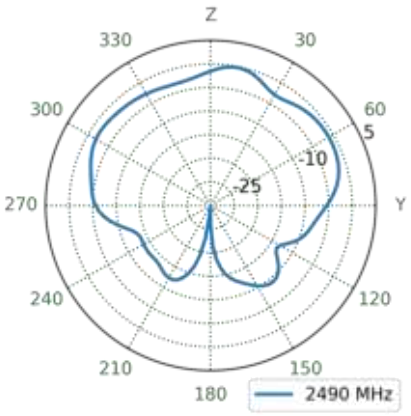
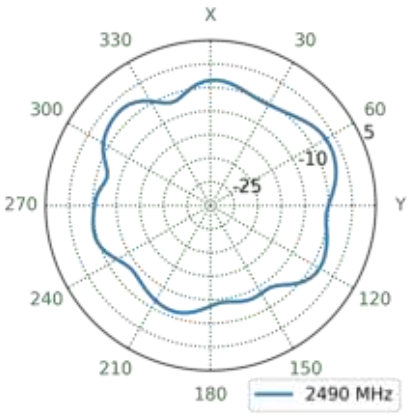
7.22 4G-5G 1 Patterns at 2490 MHz



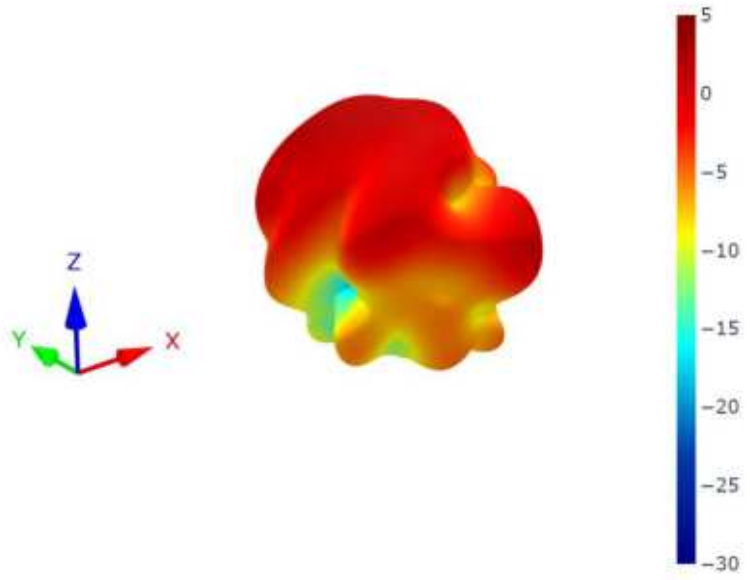
XZ Plane	YZ Plane	XY Plane
		

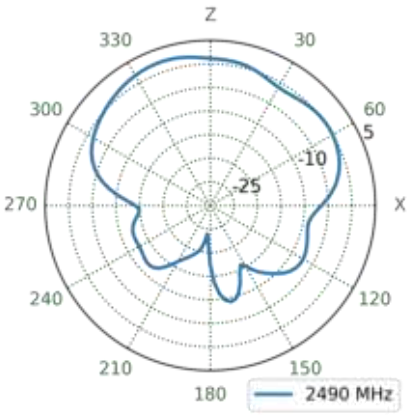
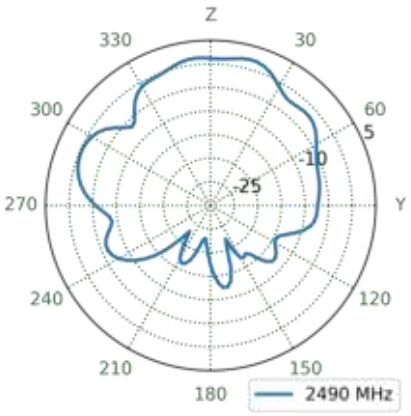
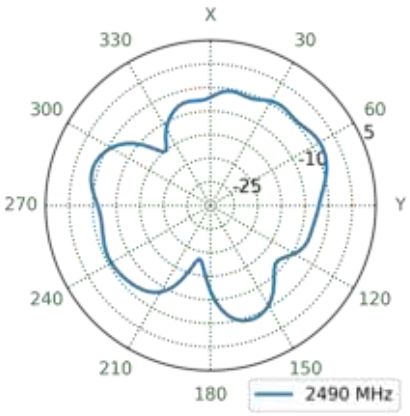
7.23 4G-5G 2 Patterns at 2490 MHz



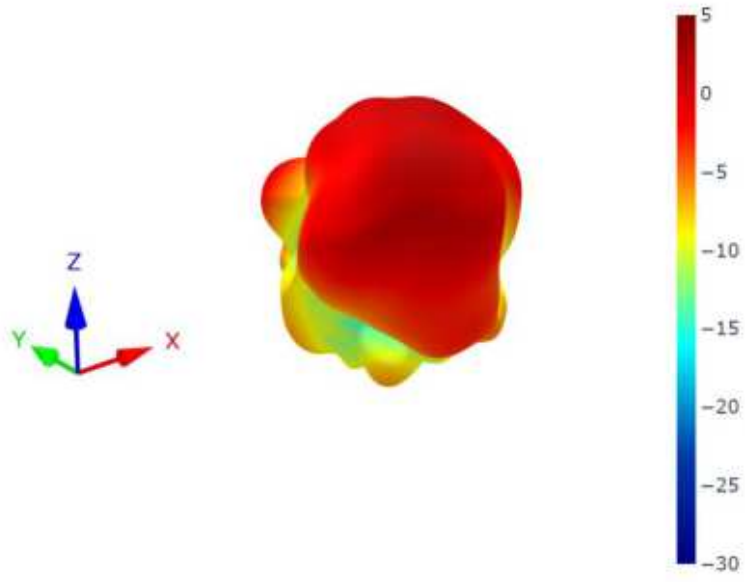
XZ Plane	YZ Plane	XY Plane
		

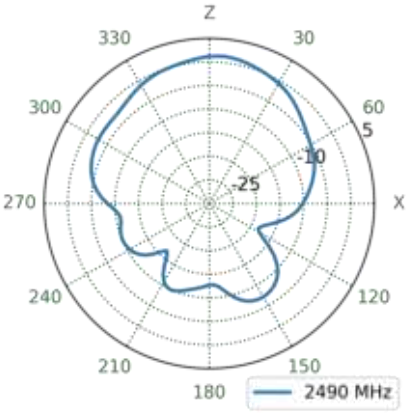
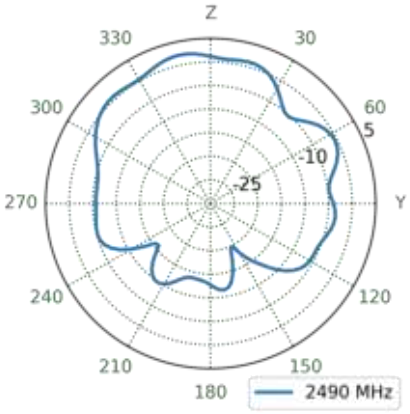
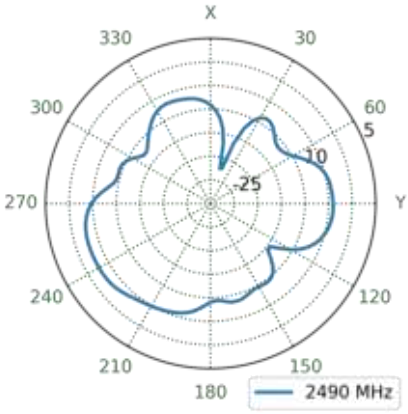
7.24 4G-5G 3 Patterns at 2490 MHz



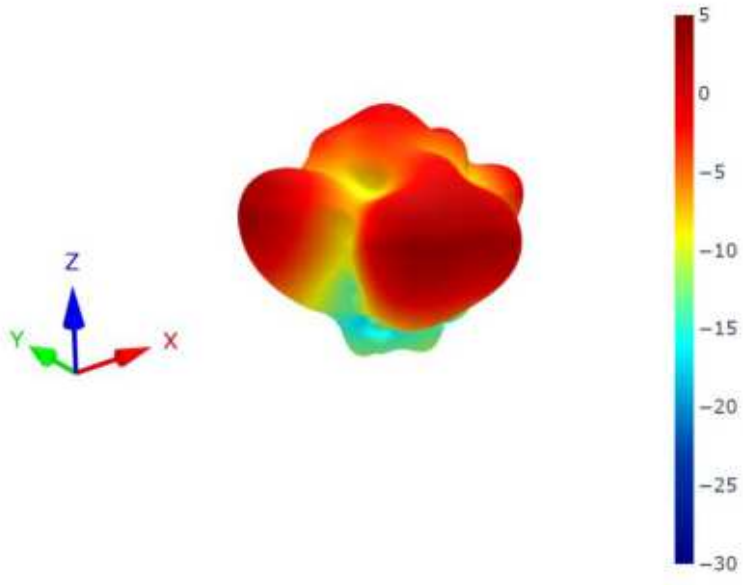
XZ Plane	YZ Plane	XY Plane
		

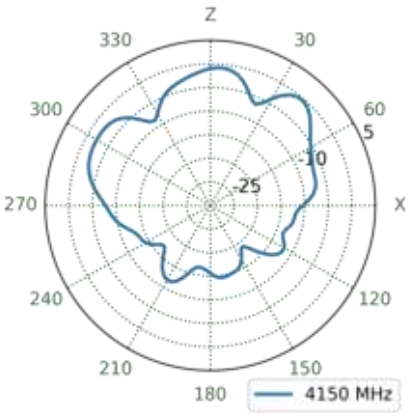
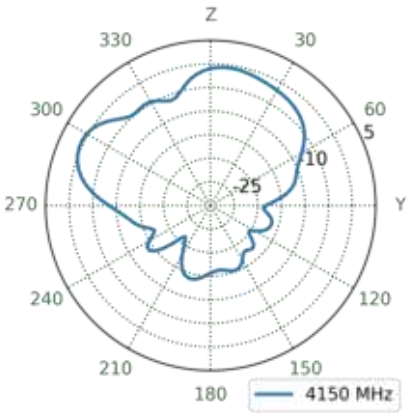
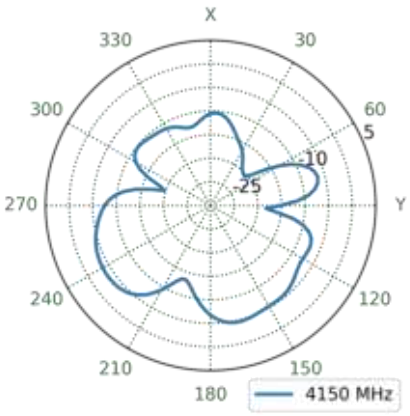
7.25 4G-5G 4 Patterns at 2490 MHz



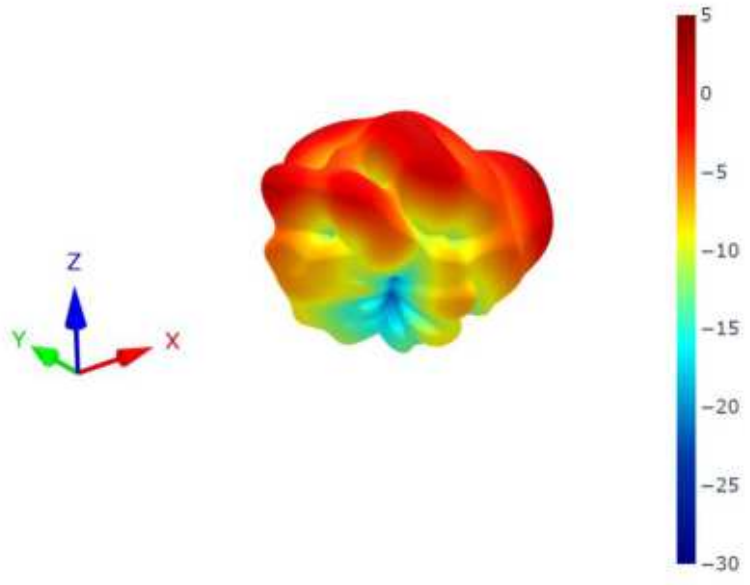
XZ Plane	YZ Plane	XY Plane
		

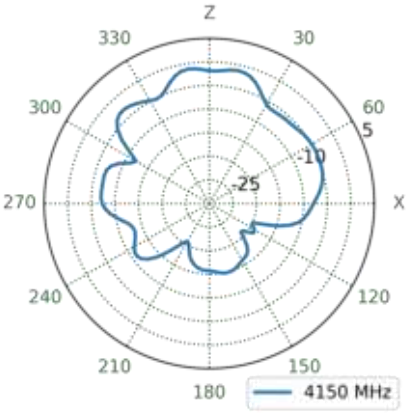
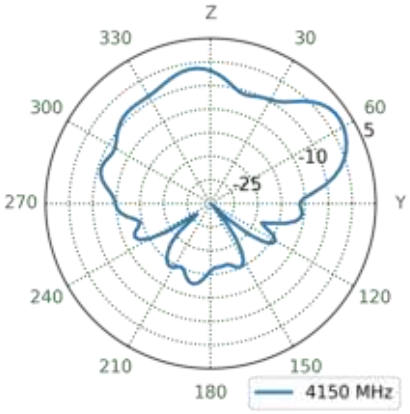
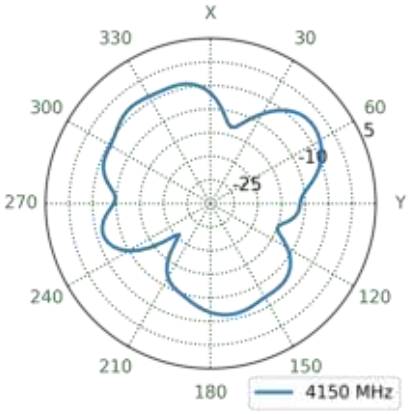
7.26 4G-5G 1 Patterns at 4150 MHz



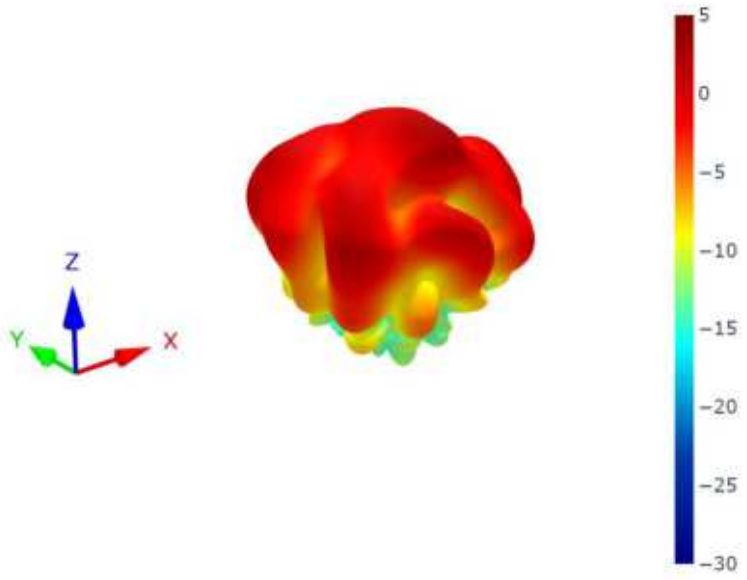
XZ Plane	YZ Plane	XY Plane
		

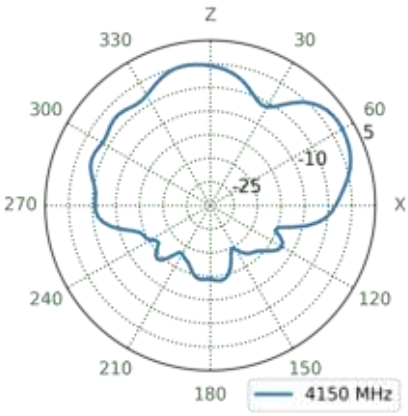
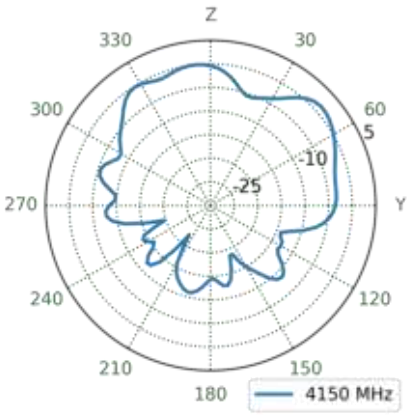
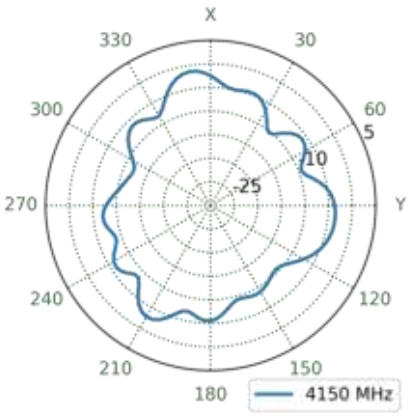
7.27 4G-5G 2 Patterns at 4150 MHz



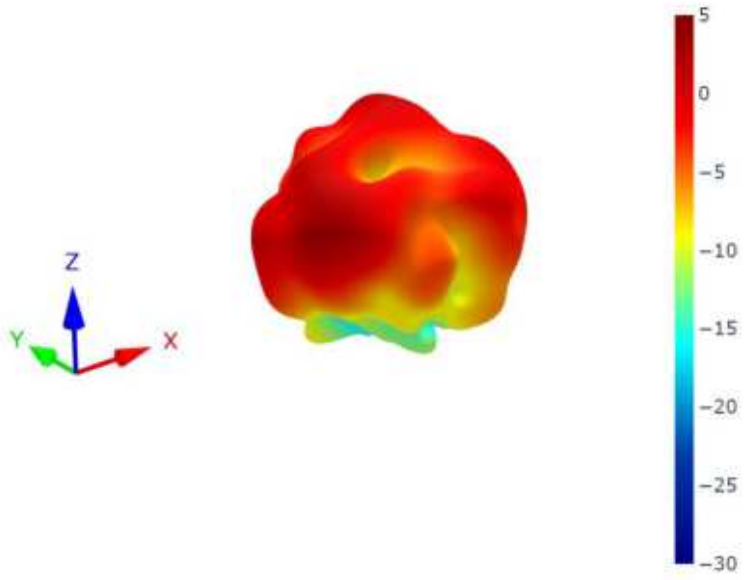
XZ Plane	YZ Plane	XY Plane
		

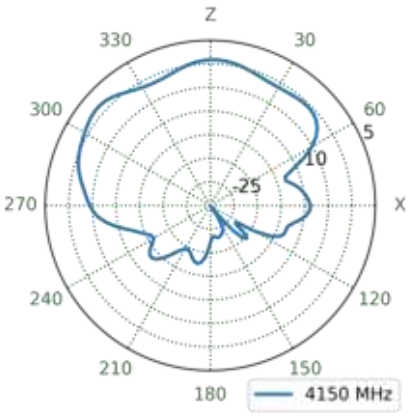
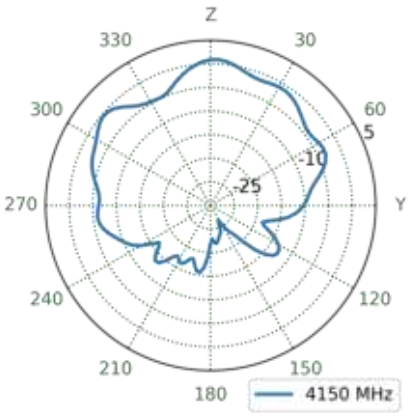
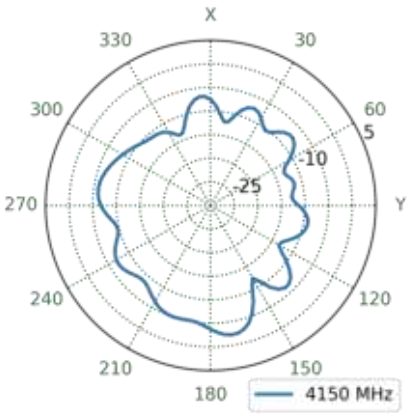
7.28 4G-5G 3 Patterns at 4150 MHz



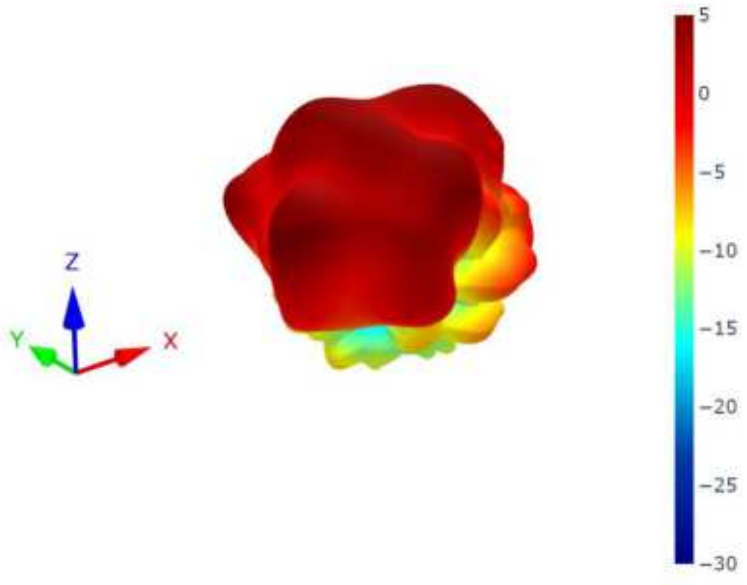
XZ Plane	YZ Plane	XY Plane
		

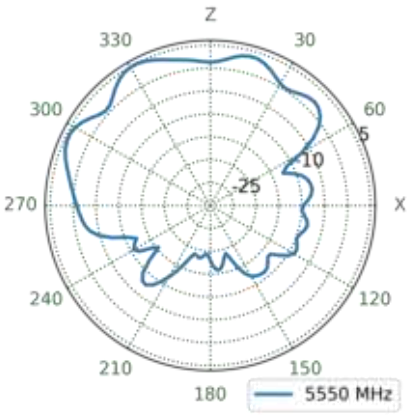
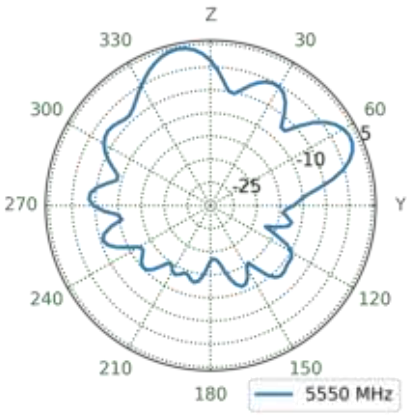
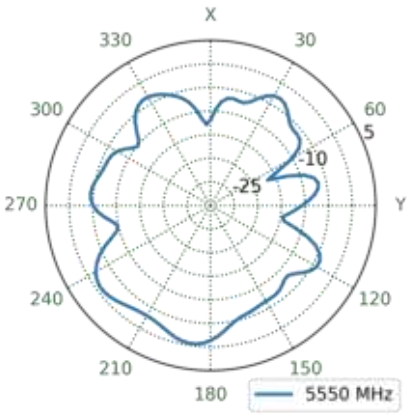
7.29 4G-5G 4 Patterns at 4150 MHz



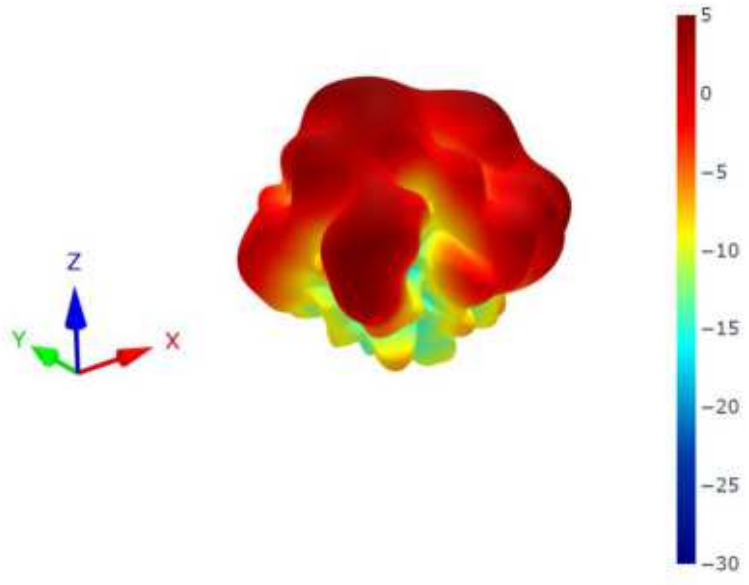
XZ Plane	YZ Plane	XY Plane
		

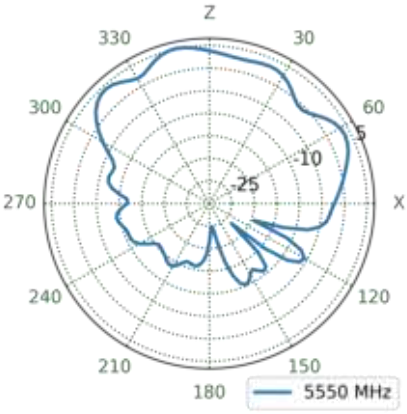
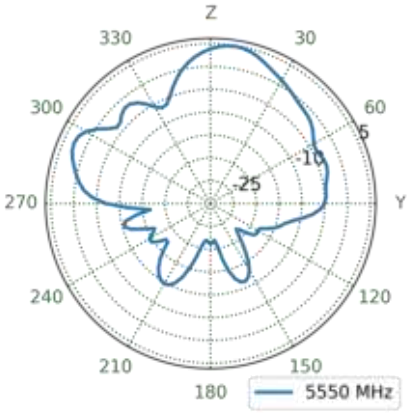
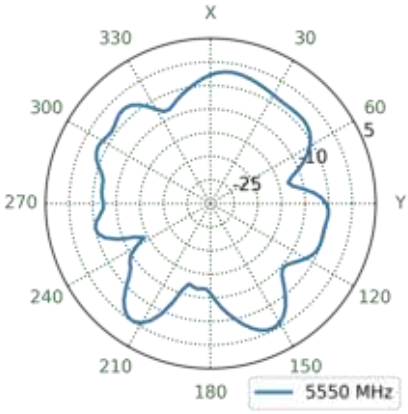
7.30 4G-5G 1 Patterns at 5550 MHz



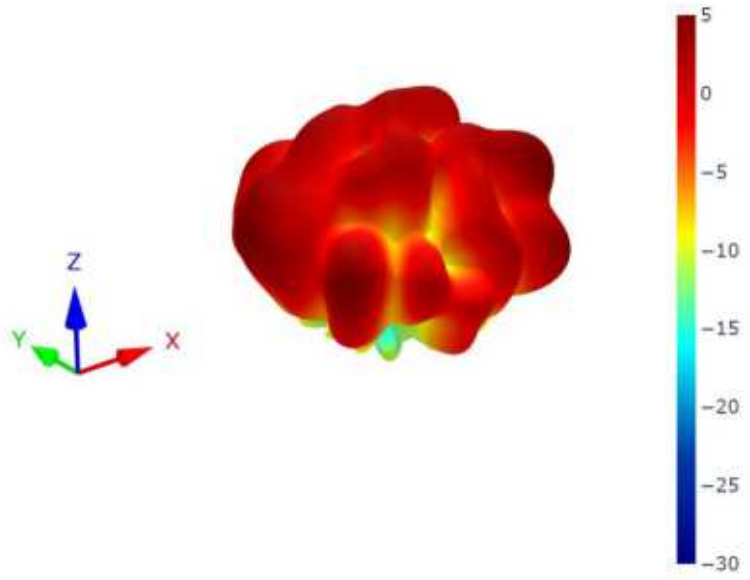
XZ Plane	YZ Plane	XY Plane
		

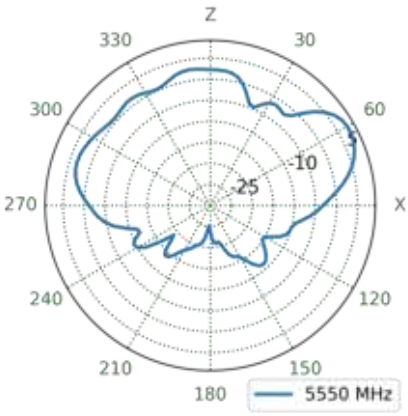
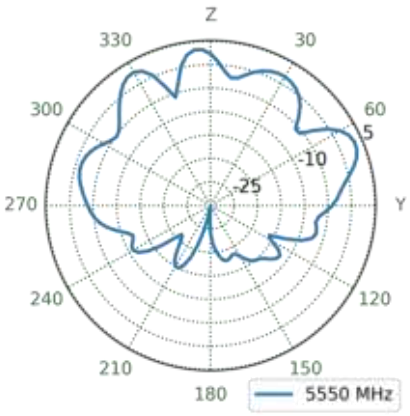
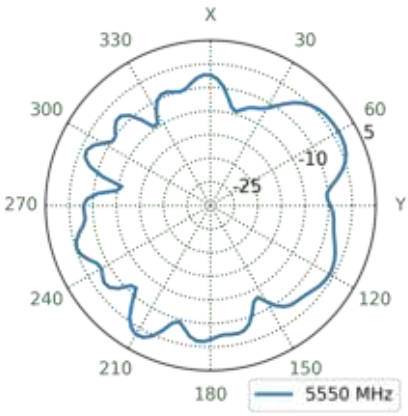
7.31 4G-5G 2 Patterns at 5550 MHz



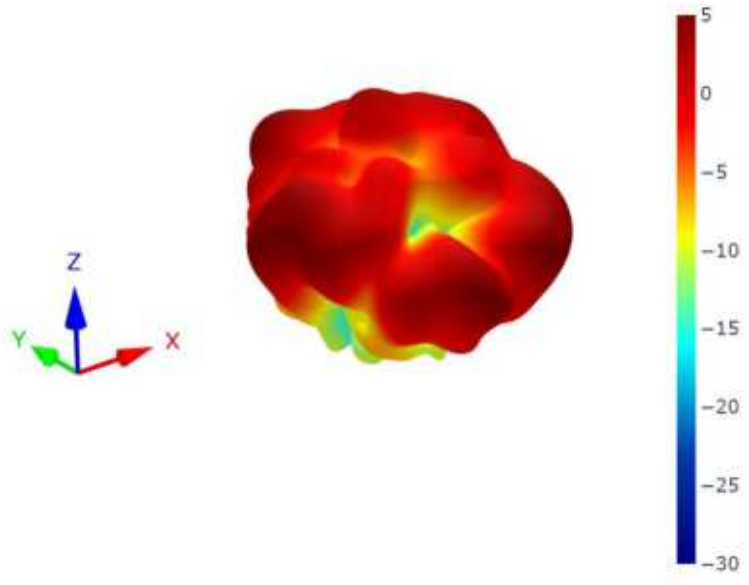
XZ Plane	YZ Plane	XY Plane
		

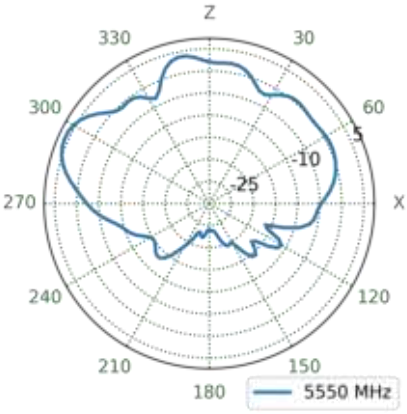
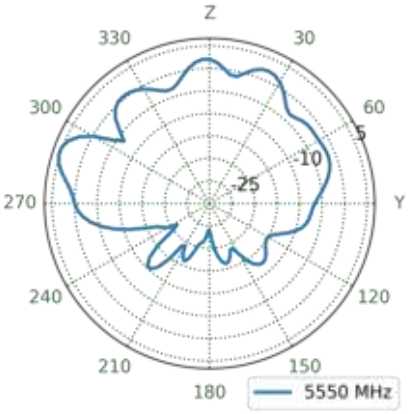
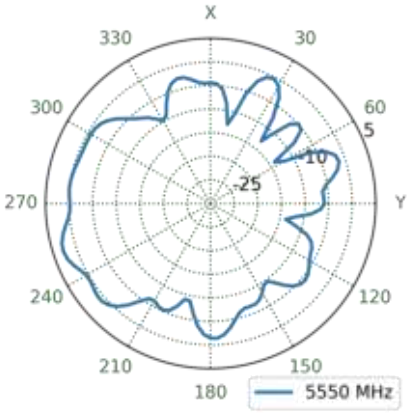
7.32 4G-5G 3 Patterns at 5550 MHz



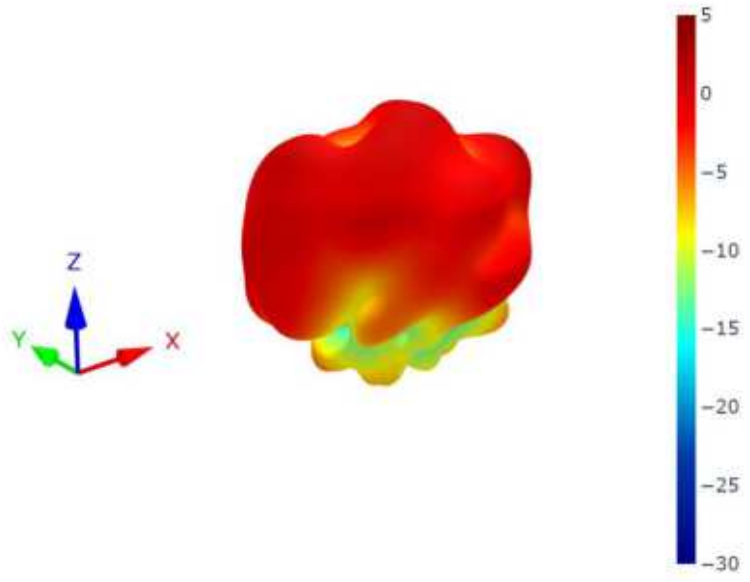
XZ Plane	YZ Plane	XY Plane
		

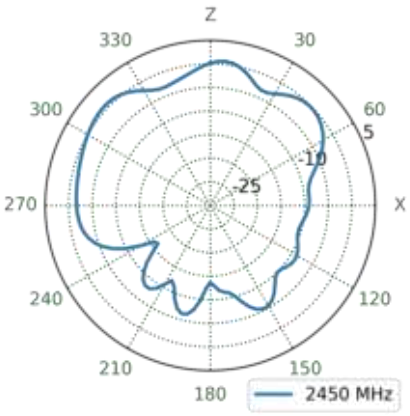
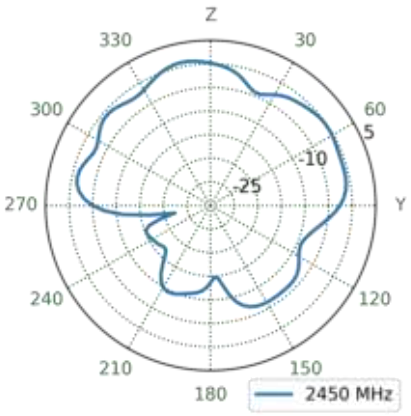
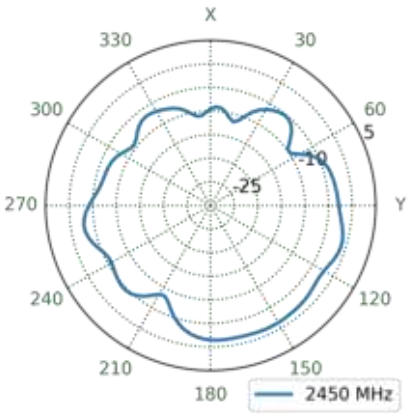
7.33 4G-5G 4 Patterns at 5550 MHz



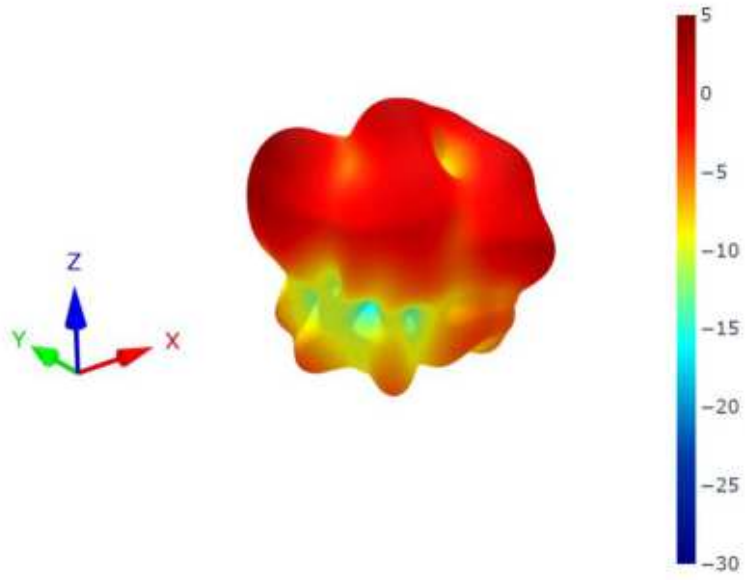
XZ Plane	YZ Plane	XY Plane
		

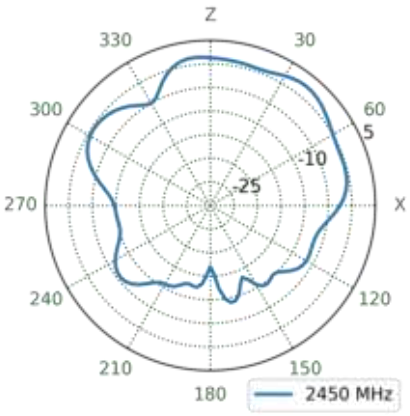
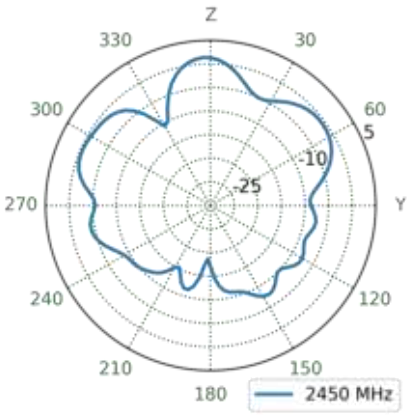
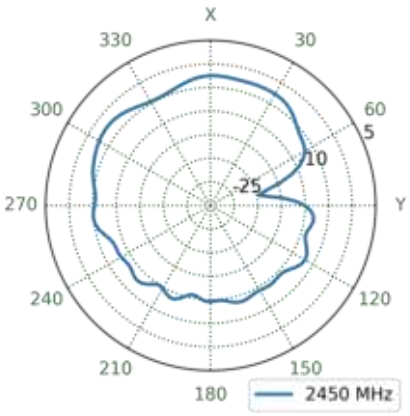
7.34 Wi-Fi 1 Patterns at 2450 MHz



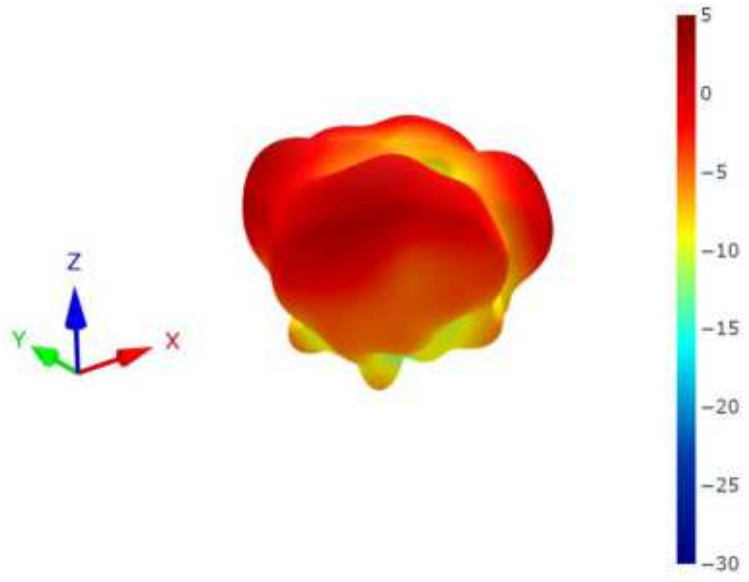
XZ Plane	YZ Plane	XY Plane
		

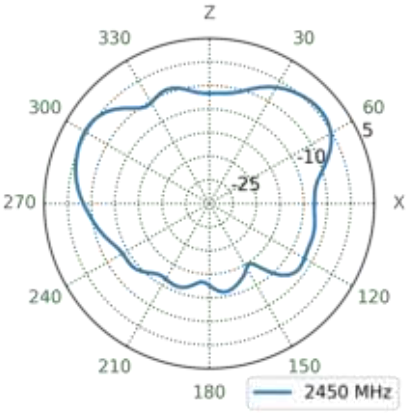
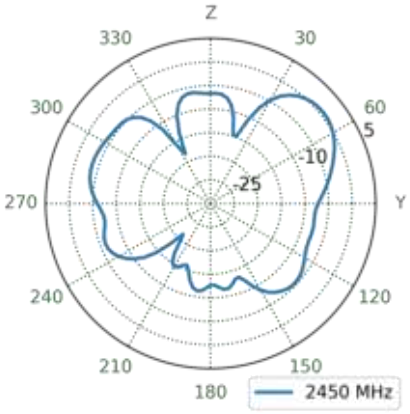
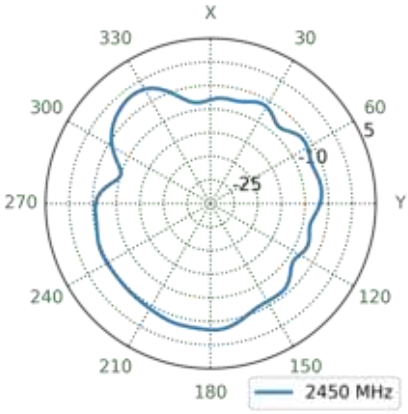
7.35 Wi-Fi 2 Patterns at 2450 MHz



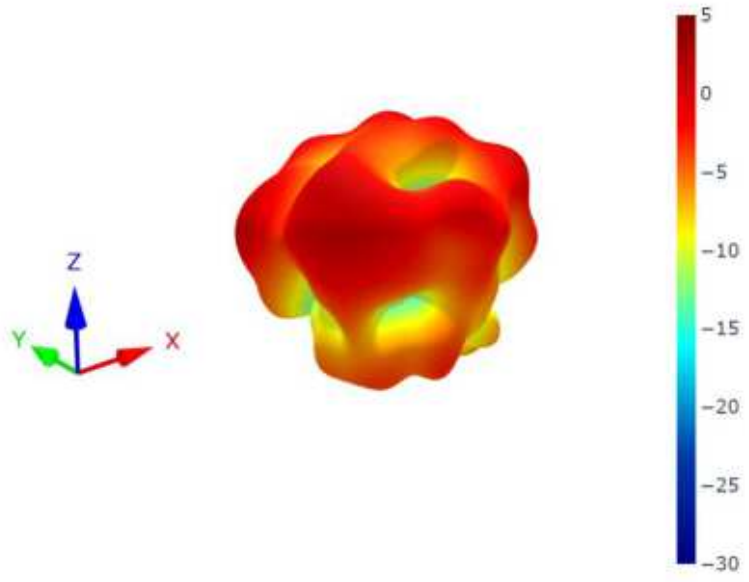
XZ Plane	YZ Plane	XY Plane
		

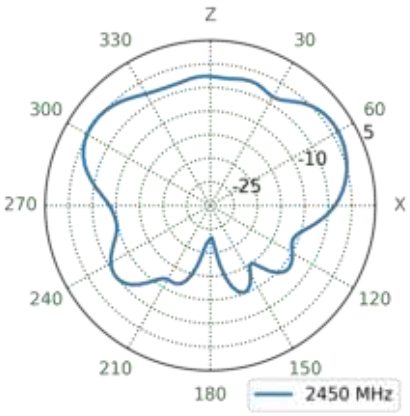
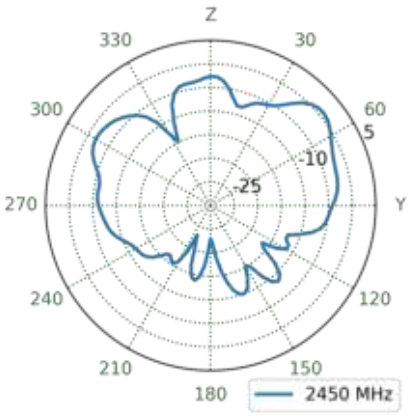
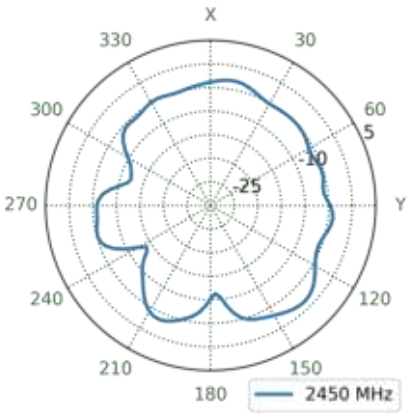
7.36 Wi-Fi 3 Patterns at 2450 MHz



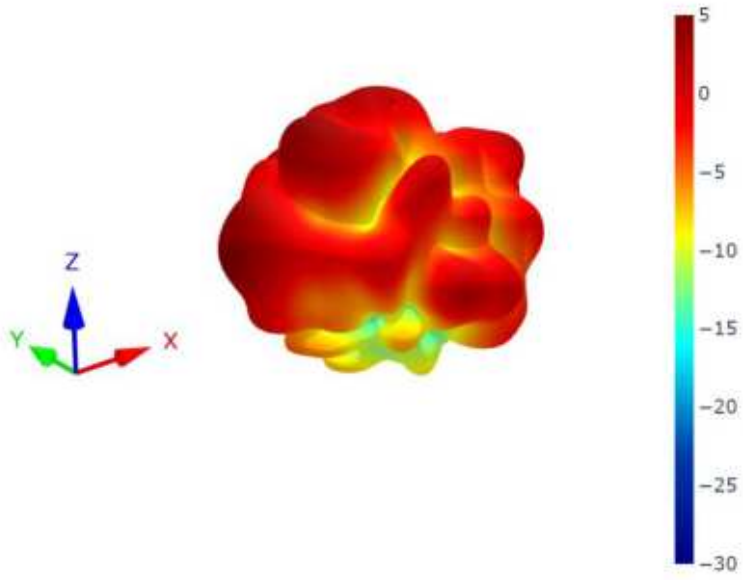
XZ Plane	YZ Plane	XY Plane
		

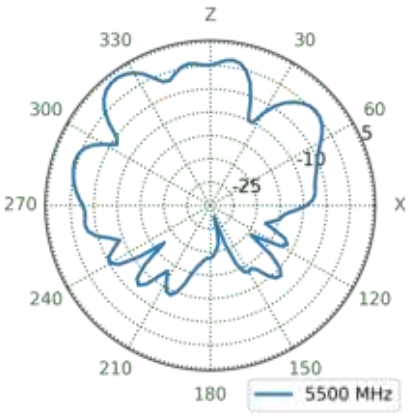
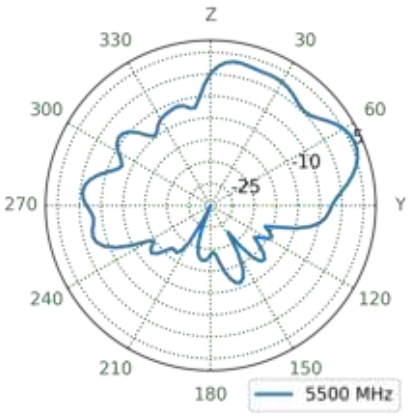
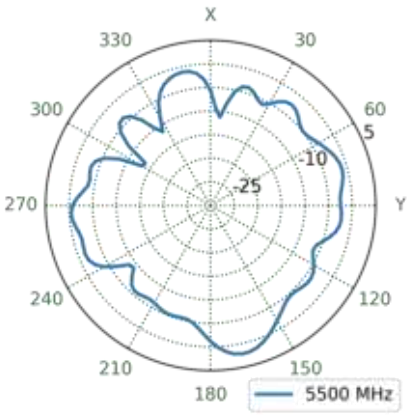
7.37 Wi-Fi 4 Patterns at 2450 MHz



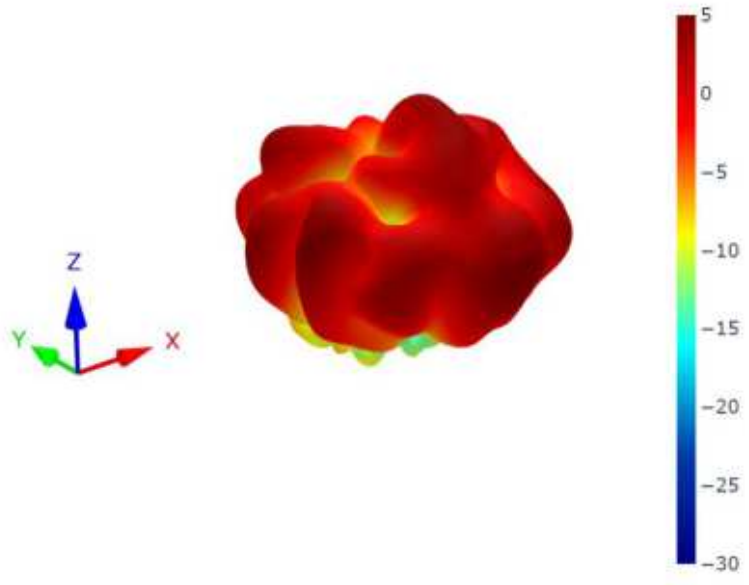
XZ Plane	YZ Plane	XY Plane
		

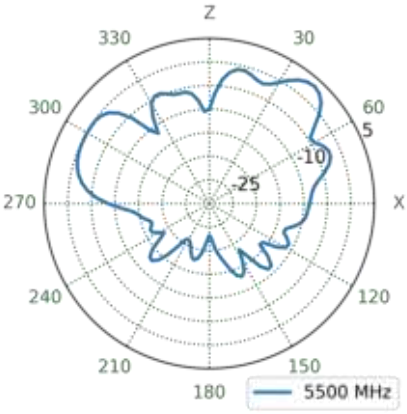
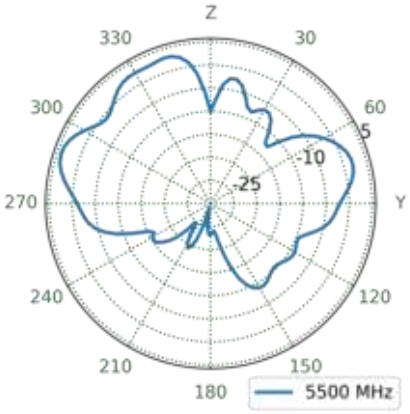
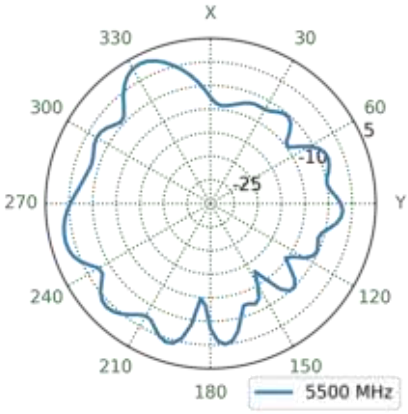
7.38 Wi-Fi 1 Patterns at 5500 MHz



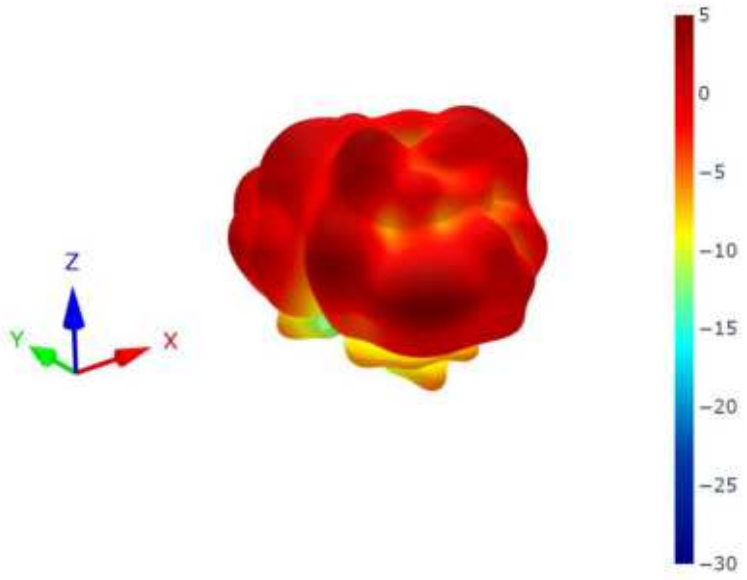
XZ Plane	YZ Plane	XY Plane
		

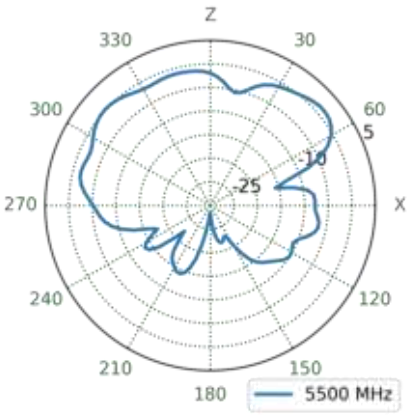
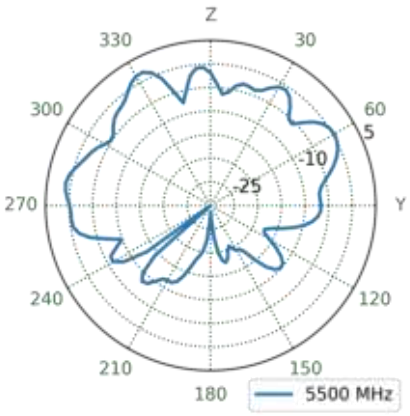
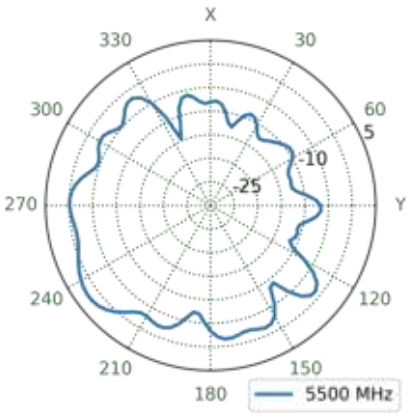
7.39 Wi-Fi 2 Patterns at 5500 MHz



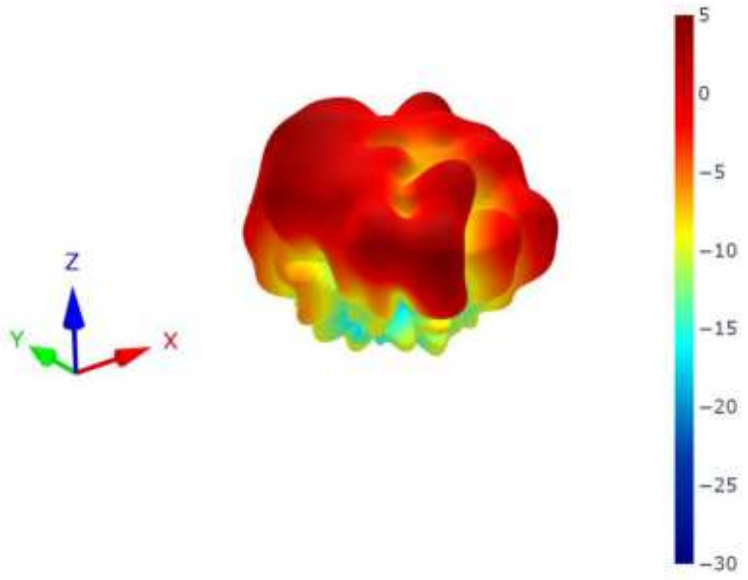
XZ Plane	YZ Plane	XY Plane
		

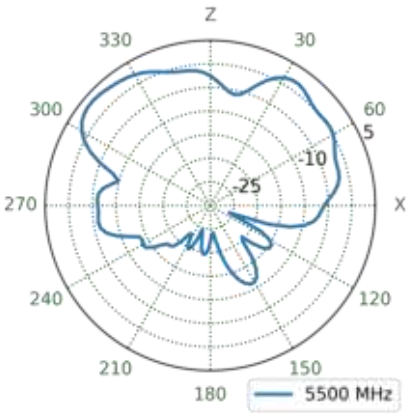
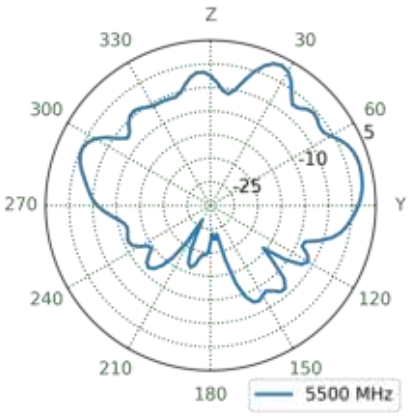
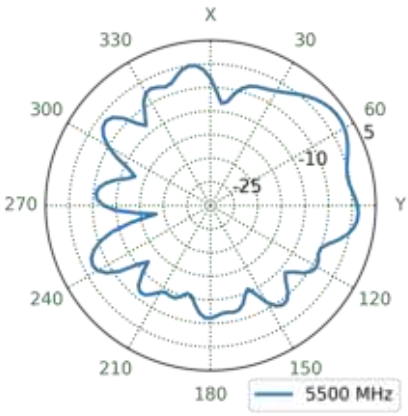
7.40 Wi-Fi 3 Patterns at 5500 MHz



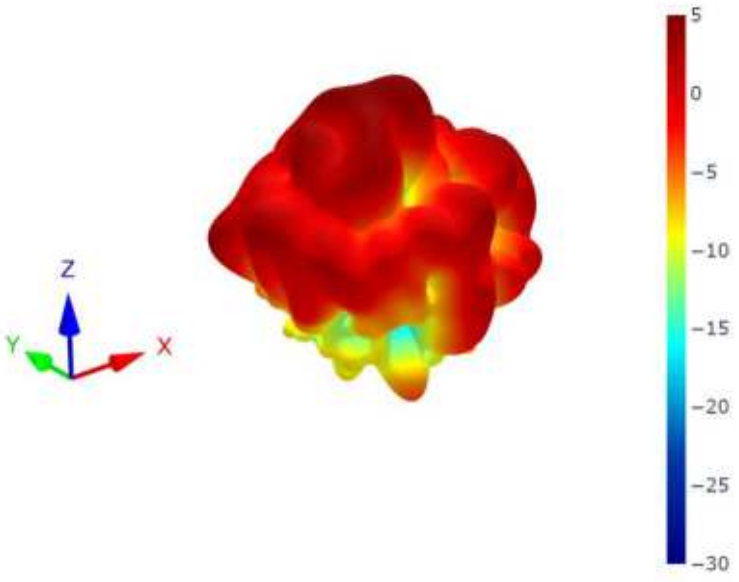
XZ Plane	YZ Plane	XY Plane
		

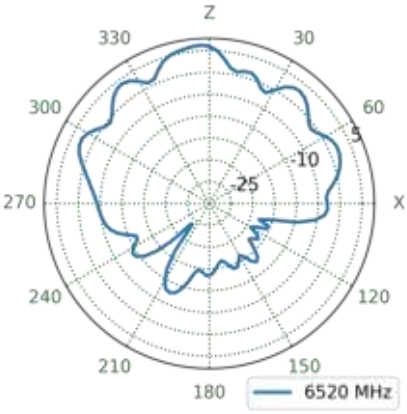
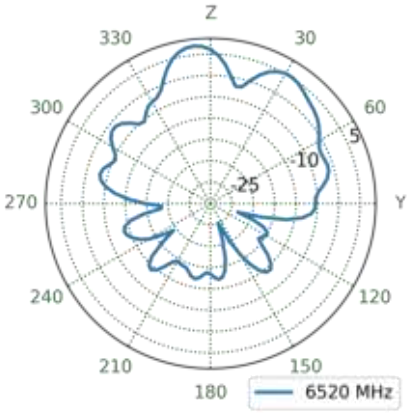
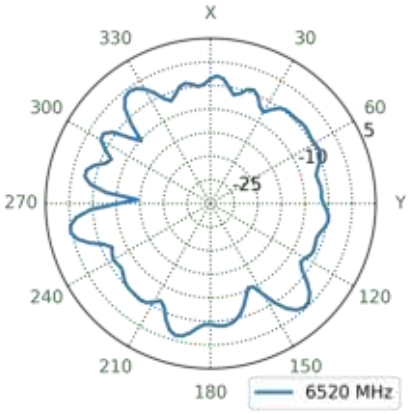
7.41 Wi-Fi 4 Patterns at 5500 MHz



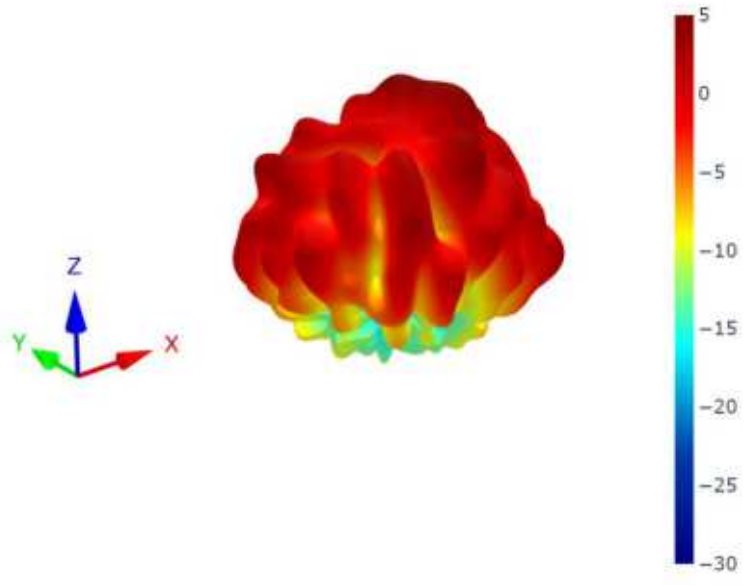
XZ Plane	YZ Plane	XY Plane
		

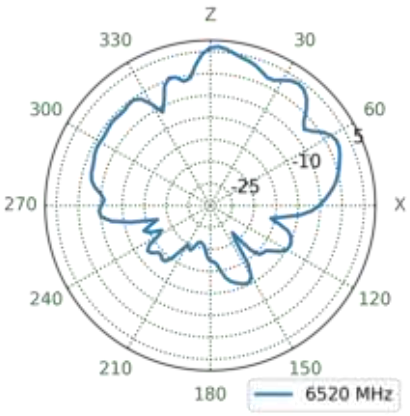
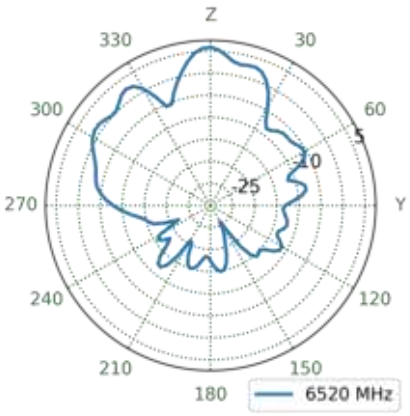
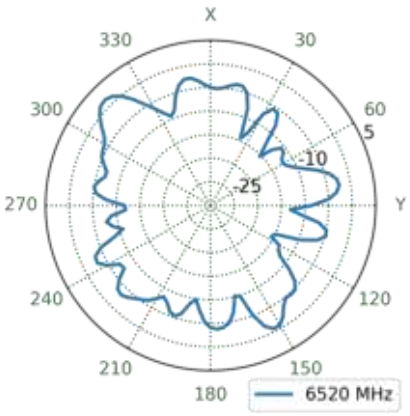
7.42 Wi-Fi 1 Patterns at 6520 MHz



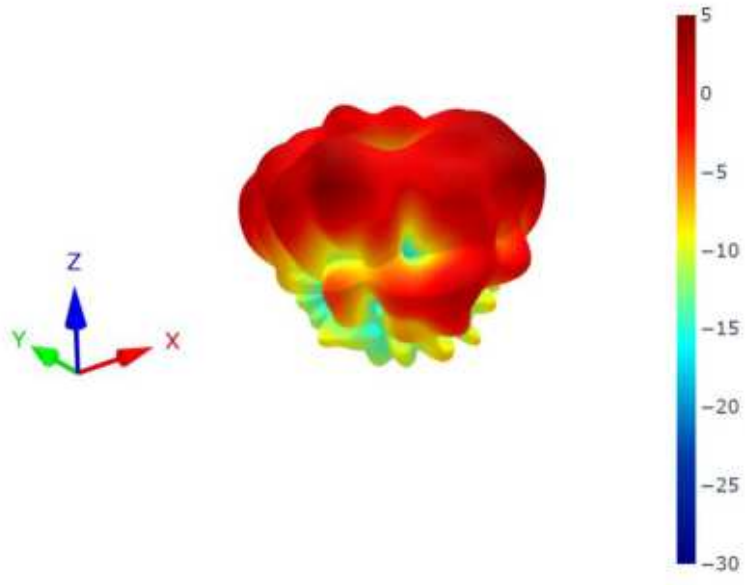
XZ Plane	YZ Plane	XY Plane
		

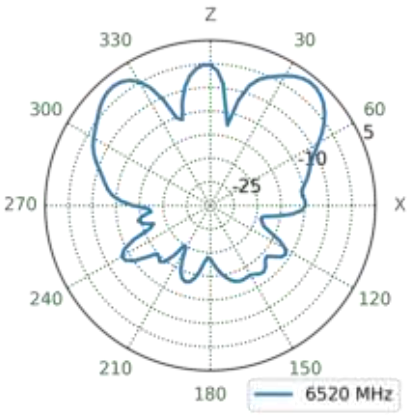
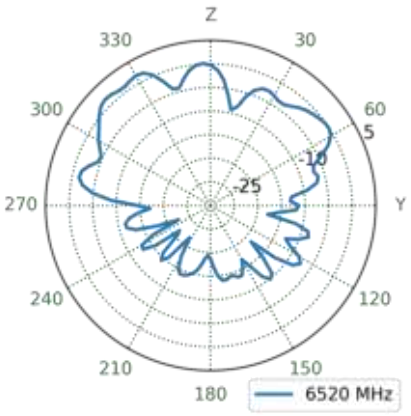
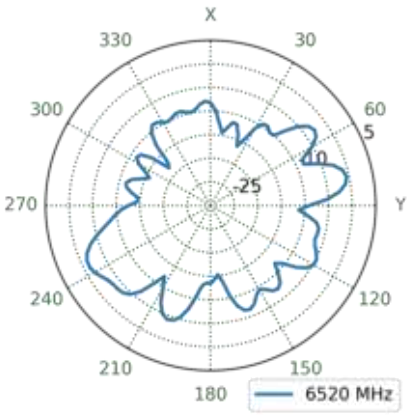
7.43 Wi-Fi 2 Patterns at 6520 MHz



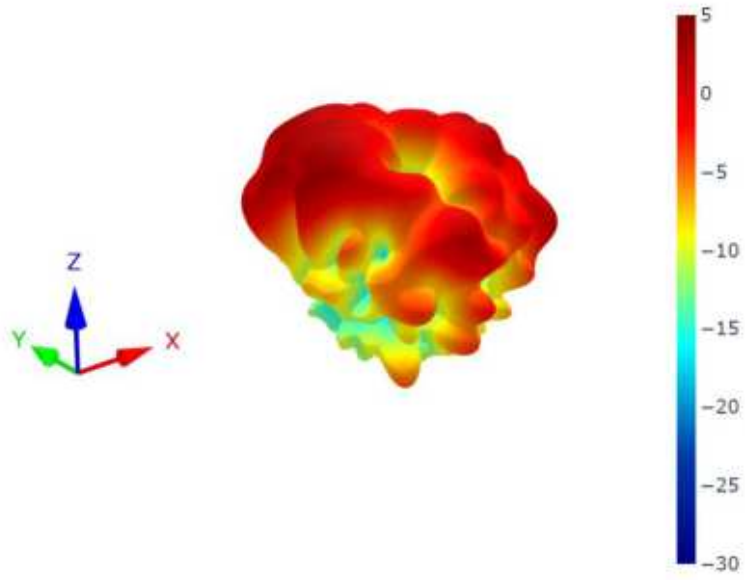
XZ Plane	YZ Plane	XY Plane
		

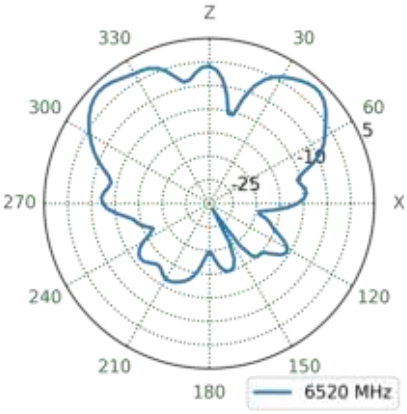
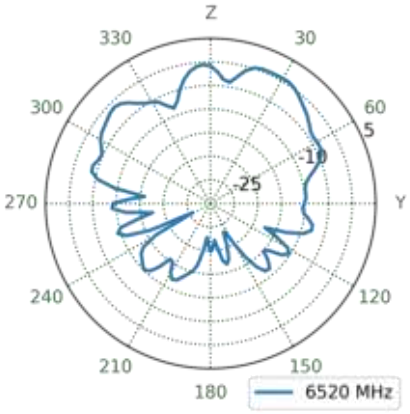
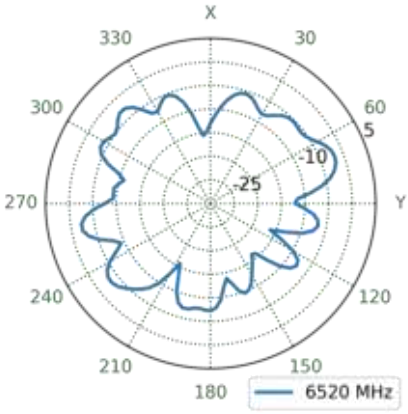
7.44 Wi-Fi 3 Patterns at 6520 MHz



XZ Plane	YZ Plane	XY Plane
		

7.45 Wi-Fi 4 Patterns at 6520 MHz



XZ Plane	YZ Plane	XY Plane
		

Changelog for the datasheet

SPE-20-8-026 - MA1509.AK.005

Revision: E (Current Version)	
Date:	2025-08-21
Notes:	Full datasheet update
Author:	Gary West

Previous Revisions

Revision: D	
Date:	2025-02-05
Notes:	Updated Installation Guidelines
Author:	Cesar Sousa

Revision: C	
Date:	2024-07-23
Notes:	Updated drawing
Author:	Conor McGrath

Revision: B	
Date:	2023-06-16
Notes:	Mechanical information updated
Author:	Cesar Sousa

Revision: A (Original First Release)	
Date:	2020-04-07
Notes:	Initial Release
Author:	Jack Conroy



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