



TAOGLAS®



Datasheet

Synergy 5-in-1 Antenna

Part No:
MA1505.AK.001

Description:

- 1*Active GNSS with RG-174 & SMA(M)
- 2*5G/4G MIMO with RG-174 & SMA(M)
- 2*Wi-Fi MIMO with RG-174 & RP-SMA(M)

Features:

- 2 x 5G/4G MIMO Antenna
- 2 x Wi-Fi 2.4GHz/5GHz MIMO Antenna
- 1 x Active 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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Antenna designed and manufactured by Taoglas

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Ireland & USA
ISO 9001:2015
Certified



Taiwan
ISO 9001:2015
Certified



1. Introduction



The Taoglas Synergy MA1505 is a 5-in-1 next-generation permanent mount antenna designed for vehicle roof applications. It has a fully IP67 rated waterproof robust PC enclosure and base. The 5 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

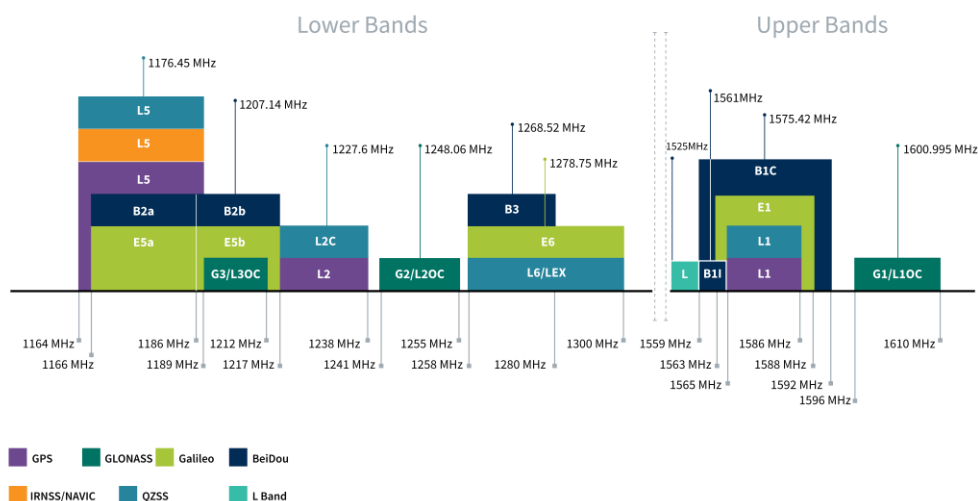
The MA1505 is ideal for applications that require highly sophisticated antennas for real-time streaming applications that demand high-speed video uplink and downlink into the cabin of the vehicle. These challenges are resolved by the highly efficient, high gain MIMO antennas, with high isolation, all of which is necessary to achieve the required signal to noise ratio and throughput.

The MA1505 can also be customized for your particular wireless application and frequency band, subject to NRE and MOQ. There are 4 x RG-174 cables, terminating in SMA(M) connectors for 5G/4G MIMO 2X2, and RP SMA(M) for Wi-Fi MIMO 2X2. There is an RG-174 cable for GNSS terminating in an SMA(M) connector.

All cable lengths and connector types are fully customizable. The Synergy MA1505 can be supplied with low loss TGC-200 cable extensions for longer cable runs. Contact your regional Taoglas customer support team for more information.

2. Specifications

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

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

5G/4G Antenna

Band	Frequency (MHz)		Efficiency (%)	Average Gain (dB)	Peak Gain (dBi)	Impedance	Max Input Power	Polarization	Radiation Pattern
5G NR/4G Band 71	617~698	MIMO 1	30.79	-5.12	-0.08	50 Ω	2W	Linear	Omni
		MIMO 2	18.62	-7.30	-0.58				
4G/3G Band 12,13,14,17,28,29	698~806	MIMO 1	30.39	-5.17	1.04				
		MIMO 2	31.96	-4.95	0.49				
4G/3G/NB-IoT/Cat M Band 5,8,18,19,20,26,27	824~960	MIMO 1	34.96	-4.56	2.03				
		MIMO 2	30.24	-5.19	1.42				
5G NR/4G Band 21,32,74,75,76	1427~1518	MIMO 1	39.48	-4.04	2.94				
		MIMO 2	43.80	-3.59	3.76				
4G/3G Band 1,2,3,4,9,23,25,35,39,66	1710~2200	MIMO 1	46.48	-3.33	4.55				
		MIMO 2	42.07	-3.76	3.31				
4G/3G Band 7,30,38,40,41	2300~2690	MIMO 1	43.45	-3.62	4.96				
		MIMO 2	44.95	-3.47	4.84				
5G NR/4G Band 22,42,48,77,78,79	3300~4200	MIMO 1	49.25	-3.08	5.82				
		MIMO 2	31.36	-5.04	3.77				
LTE5200/ Wi-Fi 5800	5150~5925	MIMO 1	49.39	-3.06	5.90				
		MIMO 2	44.49	-3.52	5.89				

Wi-Fi MIMO

Frequency (MHz)		Efficiency (%)	Average Gain (dB)	Peak Gain (dBi)	Impedance	Max Input Power	Polarization	Radiation Pattern
2400~2500	MIMO 1	47.59	-3.22	1.40	50 Ω	2W	Linear	Omni
	MIMO 2	32.75	-4.85	1.37				
5150~5850	MIMO 1	47.92	-3.19	2.33				
	MIMO 2	39.08	-4.08	2.55				

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
Sealant	Rubber Stopper and O-Ring
Weight	2.1Kg

Environmental

Ingress Protection	IP67
Temperature Range	-40°C to 85°C
Humidity	Non-condensing 65°C 95% RH
Cable Pull	RG-174 4 Kg

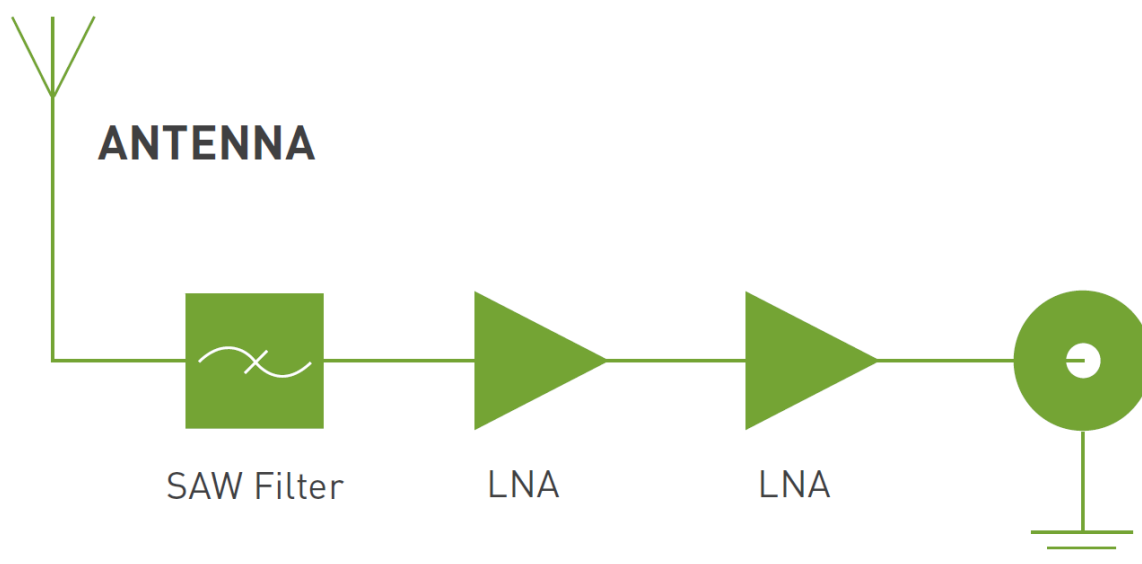
5G/4G Bands			
Band Number	5G NR / FR1 / LTE / LTE-Advanced / WCDMA / HSPA / HSPA+ / TD-SCDMA		
	Uplink	Downlink	Covered
1	UL: 1920 to 1980	DL: 2110 to 2170	✓
2	UL: 1850 to 1910	DL: 1930 to 1990	✓
3	UL: 1710 to 1785	DL: 1805 to 1880	✓
4	UL: 1710 to 1755	DL: 2110 to 2155	✓
5	UL: 824 to 849	DL: 869 to 894	✓
7	UL: 2500 to 2570	DL: 2620 to 2690	✓
8	UL: 880 to 915	DL: 925 to 960	✓
9	UL: 1749.9 to 1784.9	DL: 1844.9 to 1879.9	✓
11	UL: 1427.9 to 1447.9	DL: 1475.9 to 1495.9	✓
12	UL: 699 to 716	DL: 729 to 746	✓
13	UL: 777 to 787	DL: 746 to 756	✓
14	UL: 788 to 798	DL: 758 to 768	✓
17	UL: 704 to 716	DL: 734 to 746 (LTE only)	✓
18	UL: 815 to 830	DL: 860 to 875 (LTE only)	✓
19	UL: 830 to 845	DL: 875 to 890	✓
20	UL: 832 to 862	DL: 791 to 821	✓
21	UL: 1447.9 to 1462.9	DL: 1495.9 to 1510.9	✓
22	UL: 3410 to 3490	DL: 3510 to 3590	✓
23	UL: 2000 to 2020	DL: 2180 to 2200 (LTE only)	✓
24	UL: 1625.5 to 1660.5	DL: 1525 to 1559 (LTE only)	✓
25	UL: 1850 to 1915	DL: 1930 to 1995	✓
26	UL: 814 to 849	DL: 859 to 894	✓
27	UL: 807 to 824	DL: 852 to 869 (LTE only)	✓
28	UL: 703 to 748	DL: 758 to 803 (LTE only)	✓
29	UL: -	DL: 717 to 728 (LTE only)	✓
30	UL: 2305 to 2315	DL: 2350 to 2360 (LTE only)	✓
31	UL: 452.5 to 457.5	DL: 462.5 to 467.5 (LTE only)	✗
32	UL: -	DL: 1452 - 1496	✓
35		1850 to 1910	✓
38		2570 to 2620	✓
39		1880 to 1920	✓
40		2300 to 2400	✓
41		2496 to 2690	✓
42		3400 to 3600	✓
43		3600 to 3800	✓
48		3550 to 3700	✓
66	UL: 1710-1780	DL: 2110-2200	✓
71		617 to 698	✓
74/75/76		1427 to 1518	✓
78		3300 to 3800	✓
79		4400 to 5000	✓

* Covered Bands represent greater than 20% efficiency

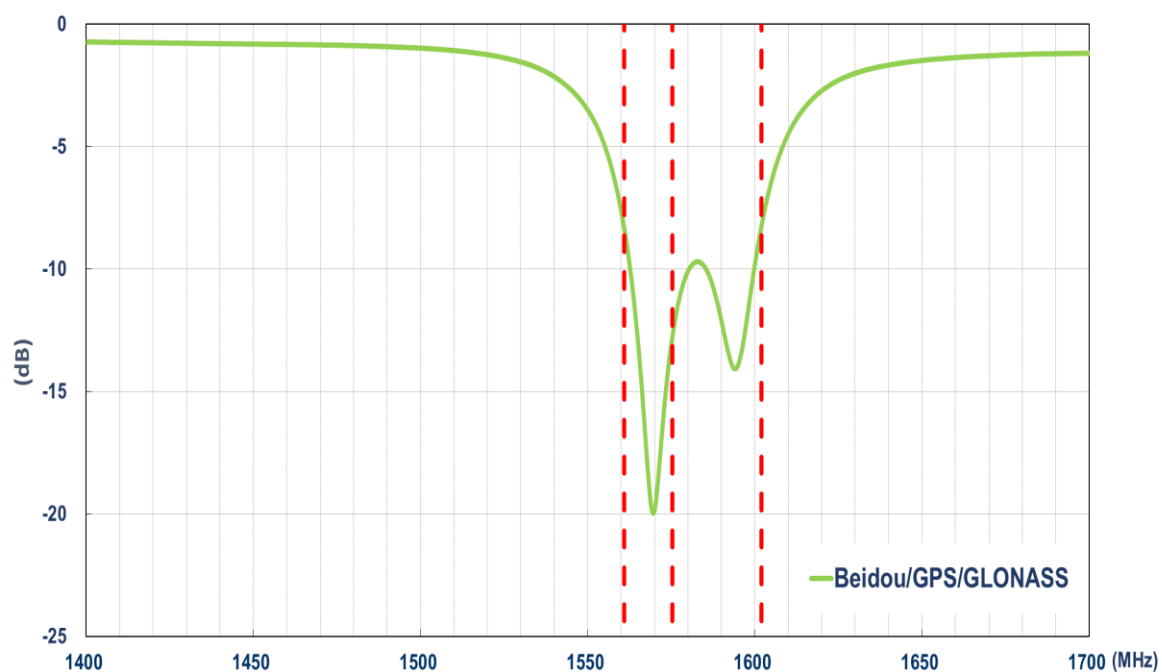
*Measured with 5m cable

3. Active Antenna Characteristics

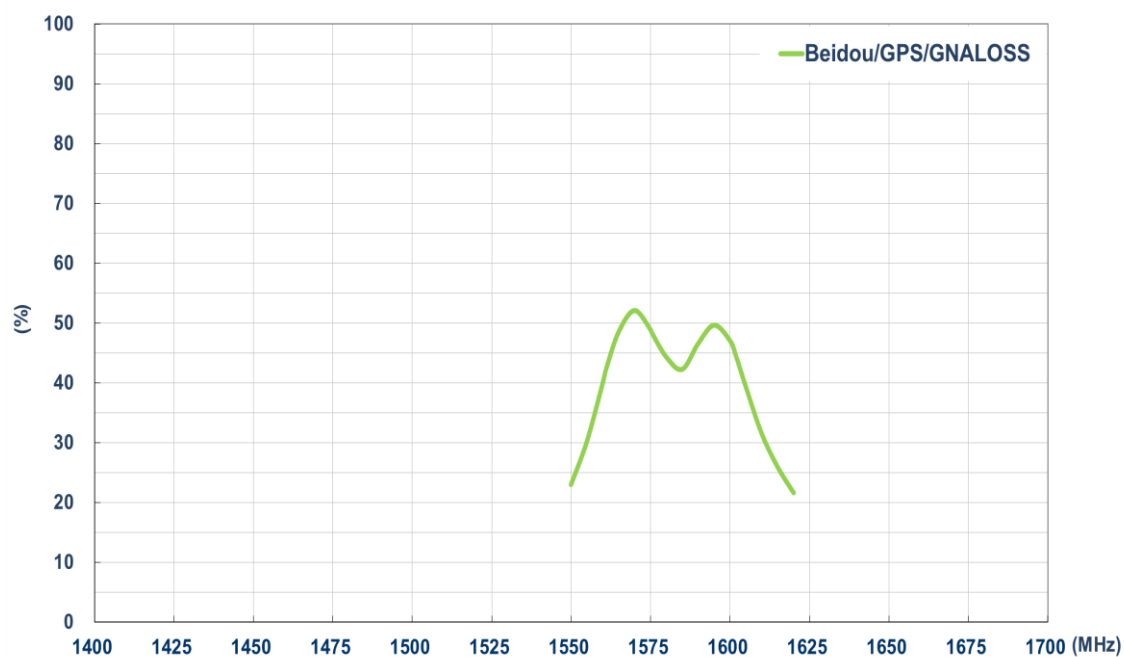
3.1 Block Diagram (Active antenna)



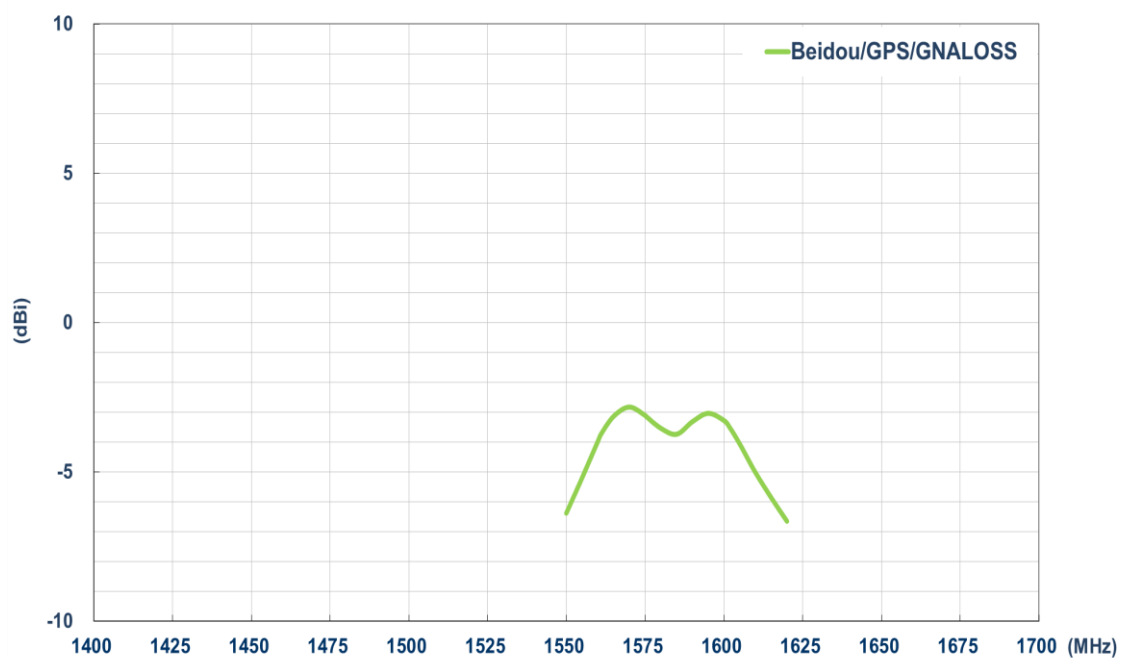
3.2 Passive Antenna Return Loss



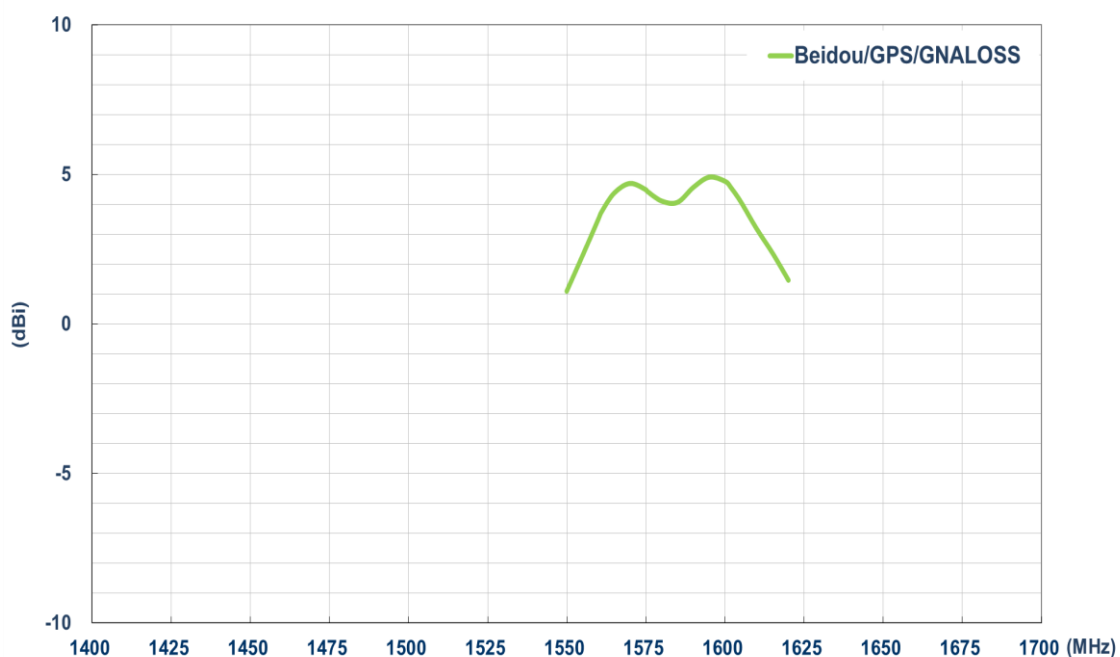
3.3 Passive Antenna Efficiency



3.4 Passive Antenna Average Gain

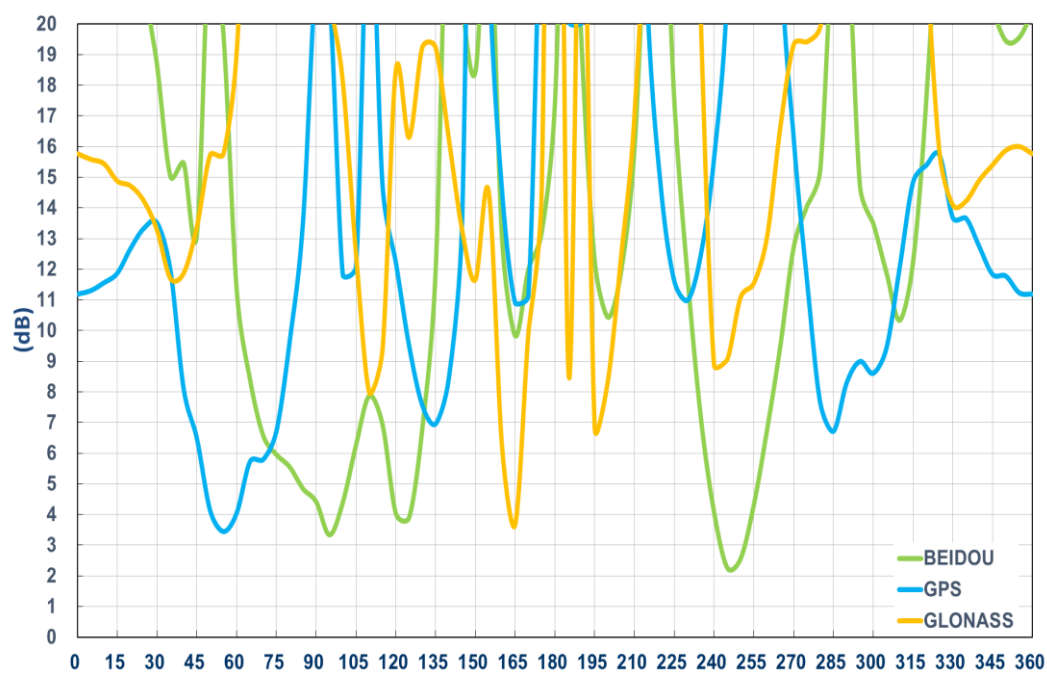


3.5 Passive Antenna Peak Gain

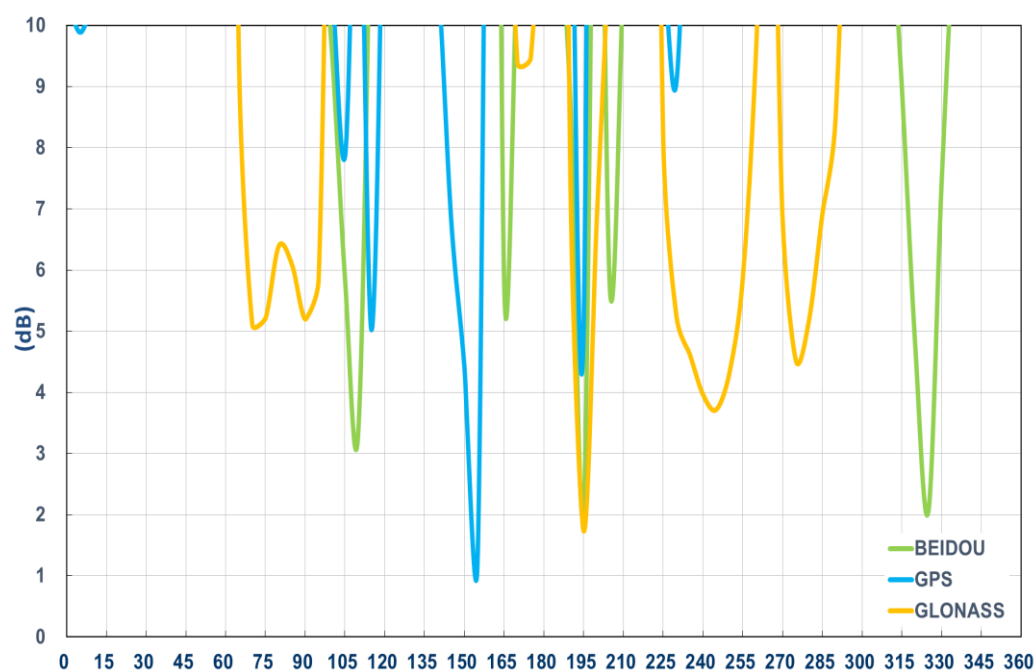


3.6 Passive Antenna Axial Ratio (Zenith is at 0°)

XZ-plane

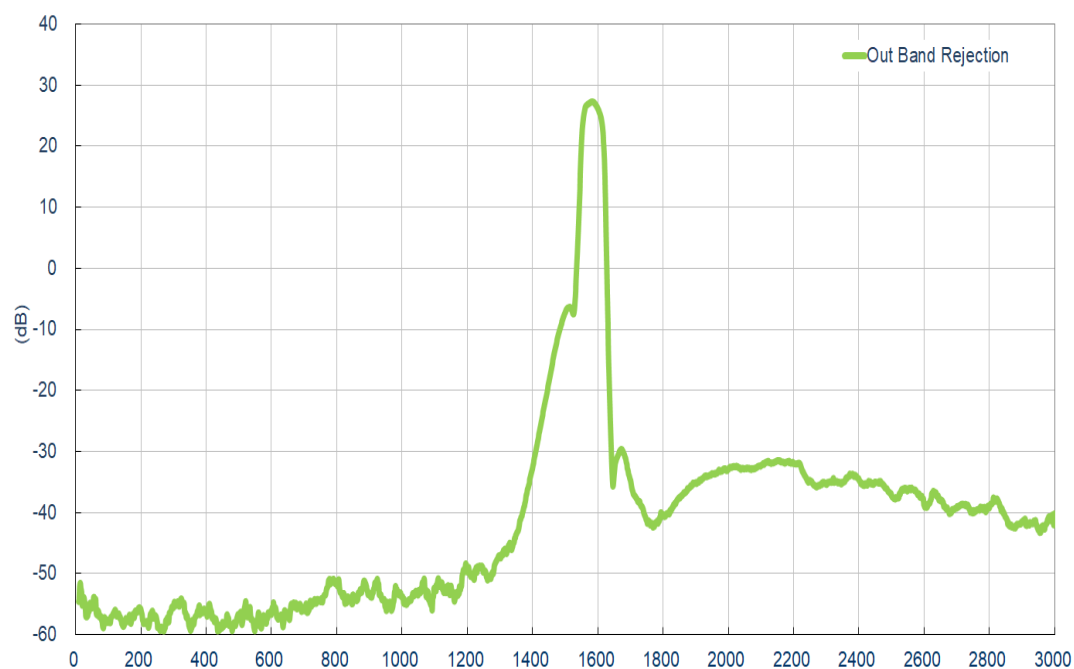


YZ-plane

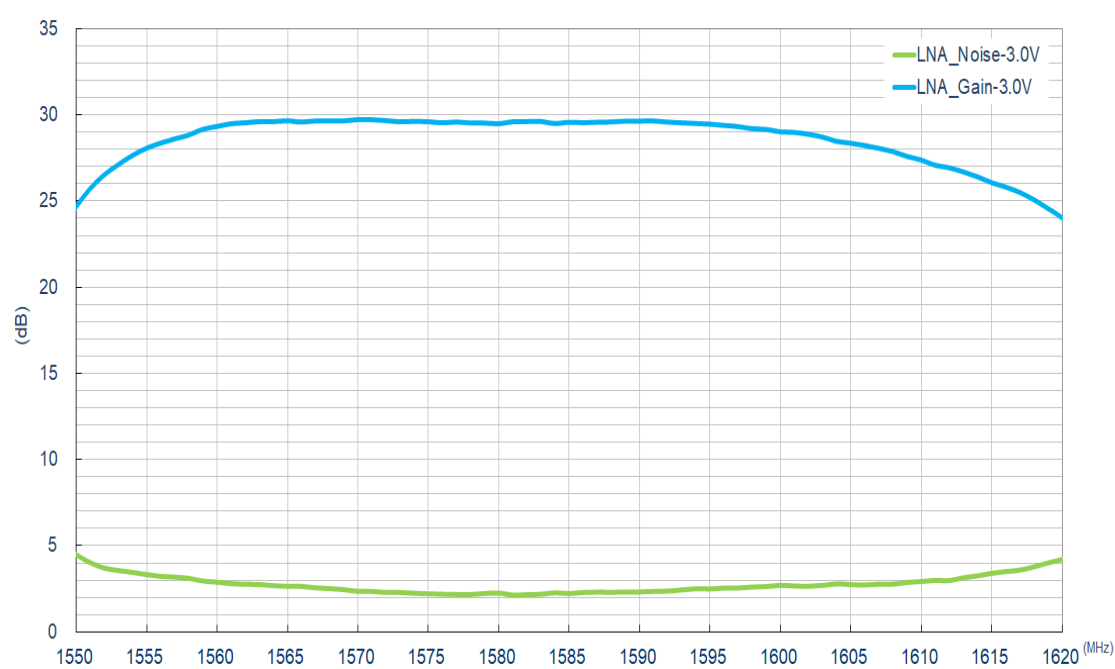


3.7 Active measurements

LNA Gain @ 3.0V

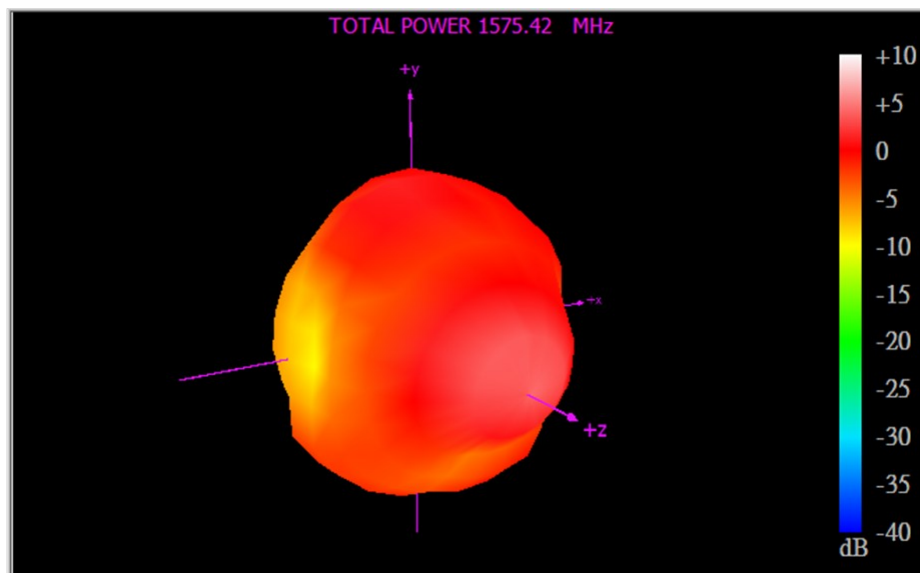


Noise Figure @ 3.0V

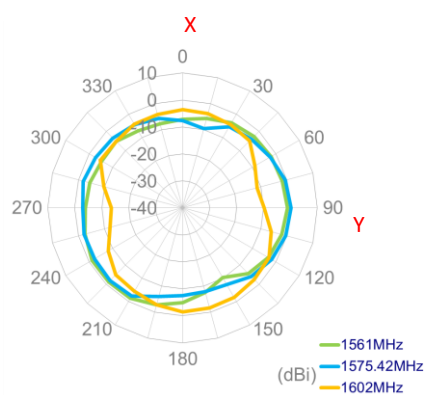


3.8 Passive Antenna Radiation Patterns

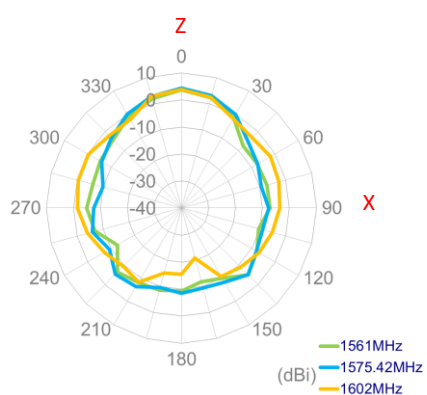
1575.42MHz



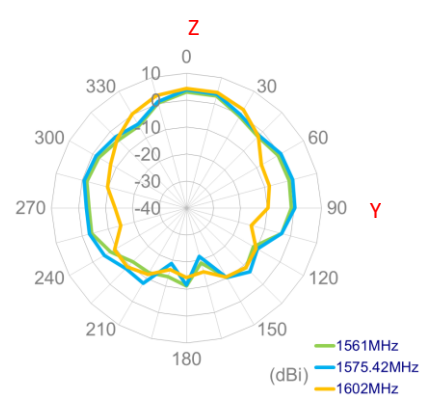
XY Plane



XZ Plane



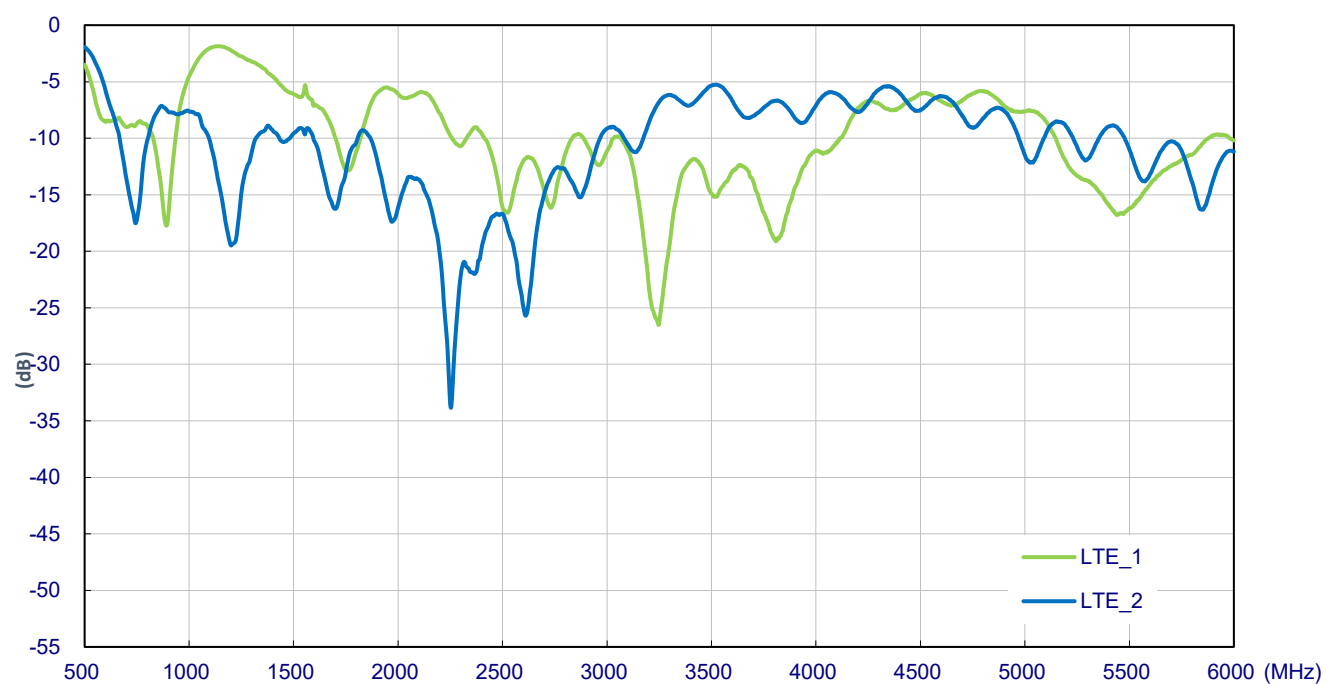
YZ Plane



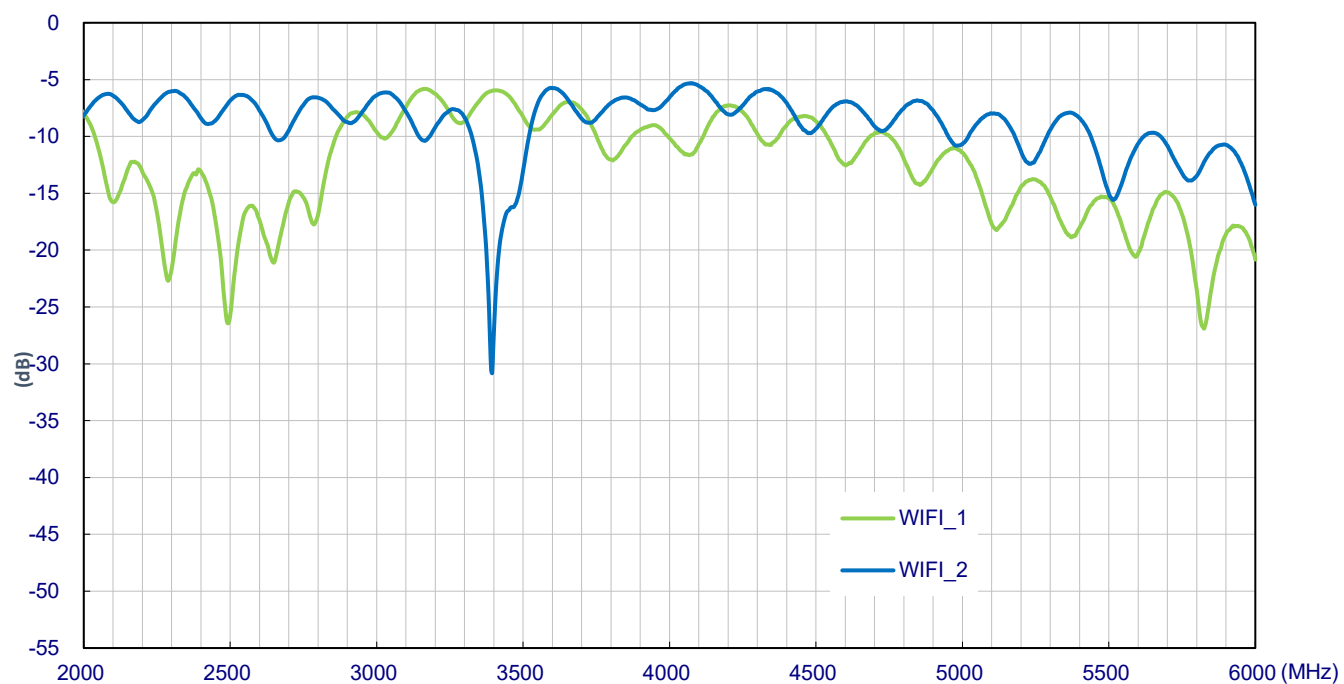
4. Antenna Characteristics

4.1 Return Loss

5G/4G MIMO

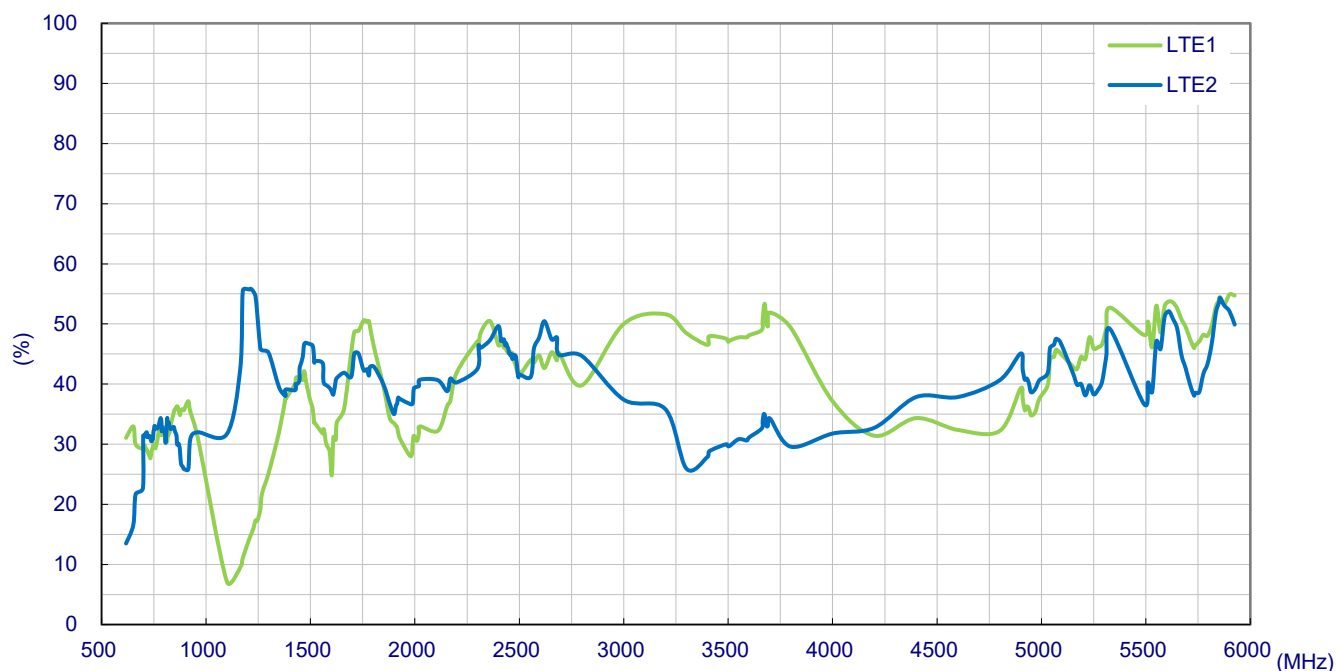


Wi-Fi MIMO

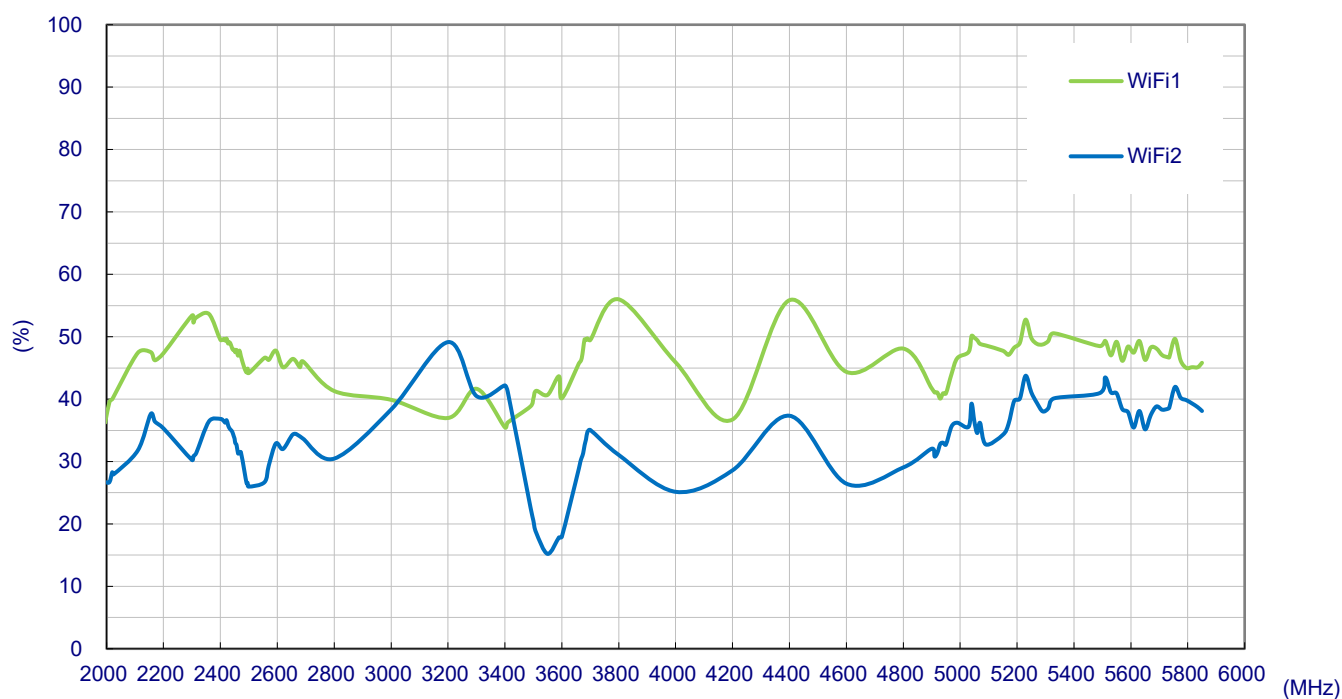


4.2 Efficiency

5G/4G MIMO

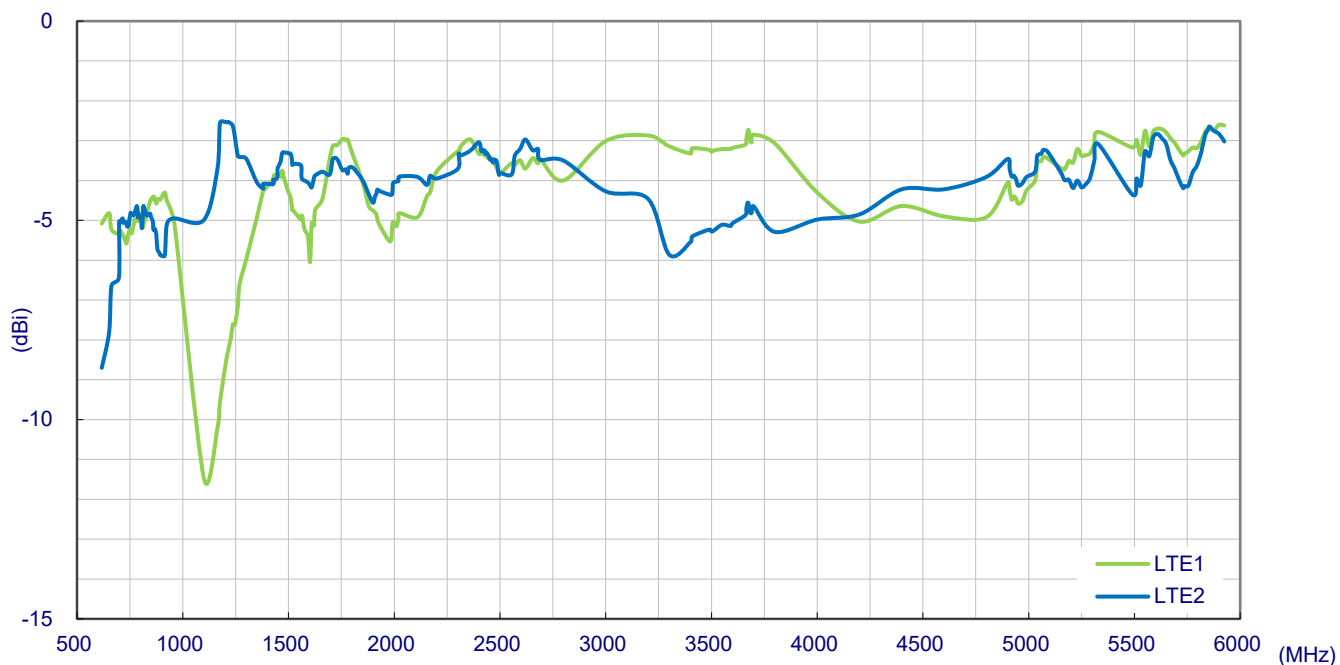


Wi-Fi MIMO

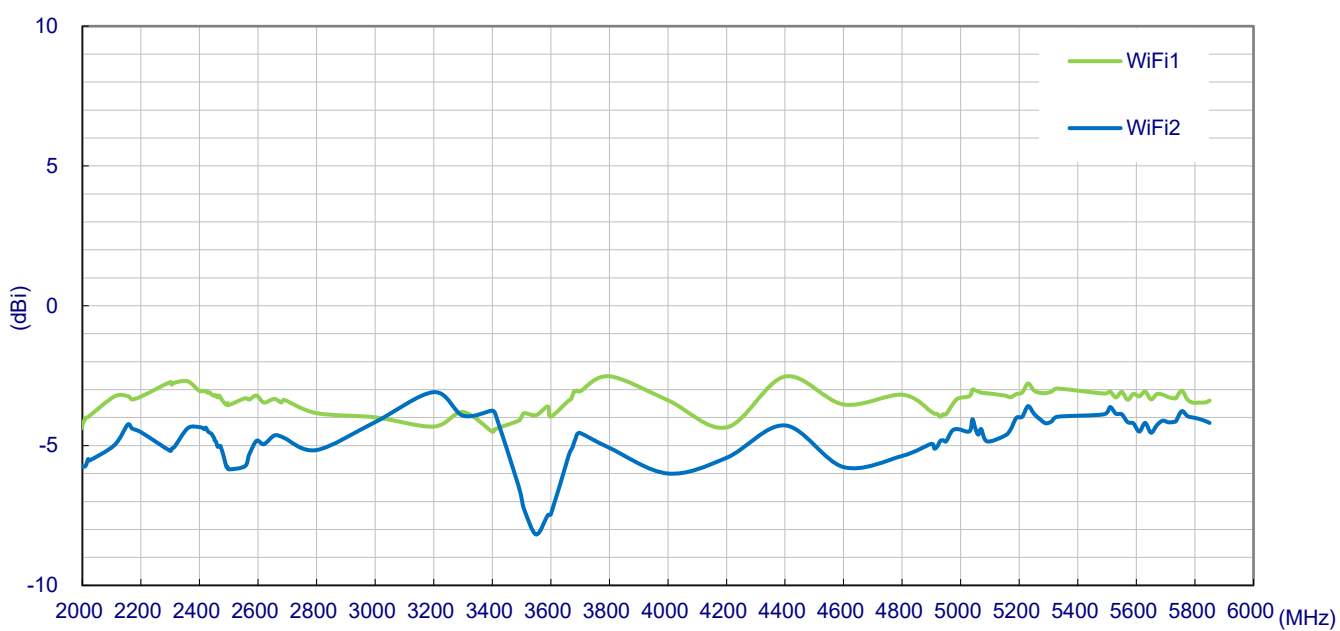


4.3 Average Gain

5G/4G MIMO

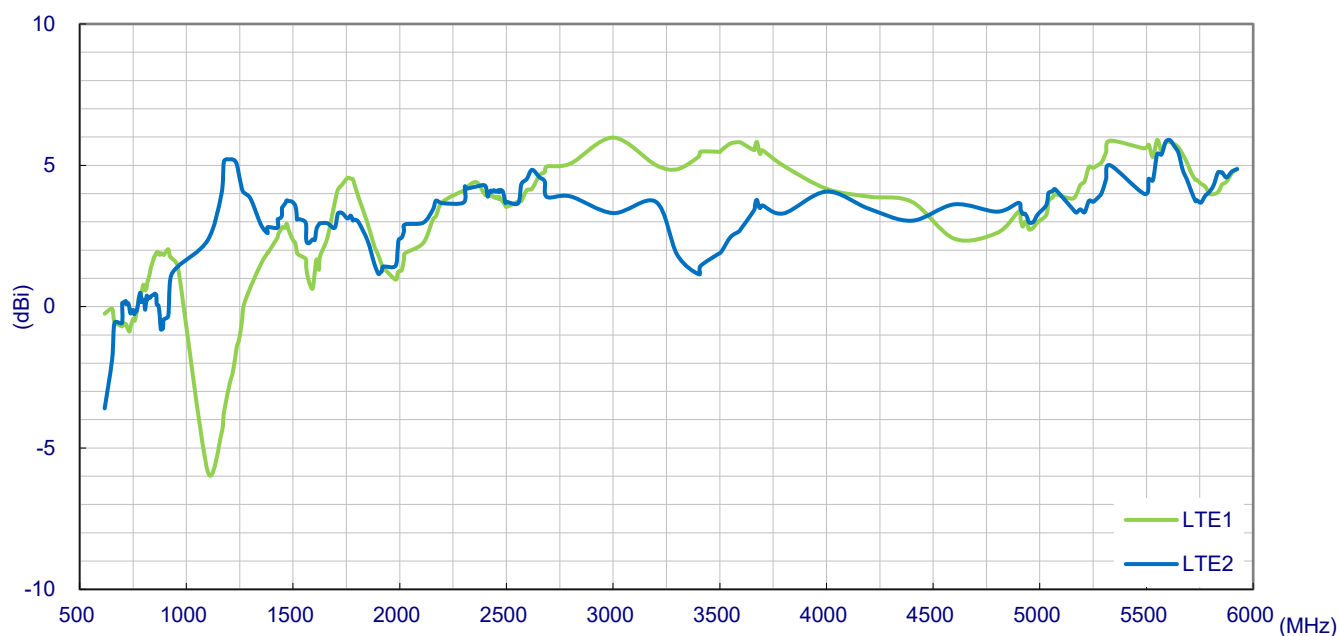


Wi-Fi MIMO

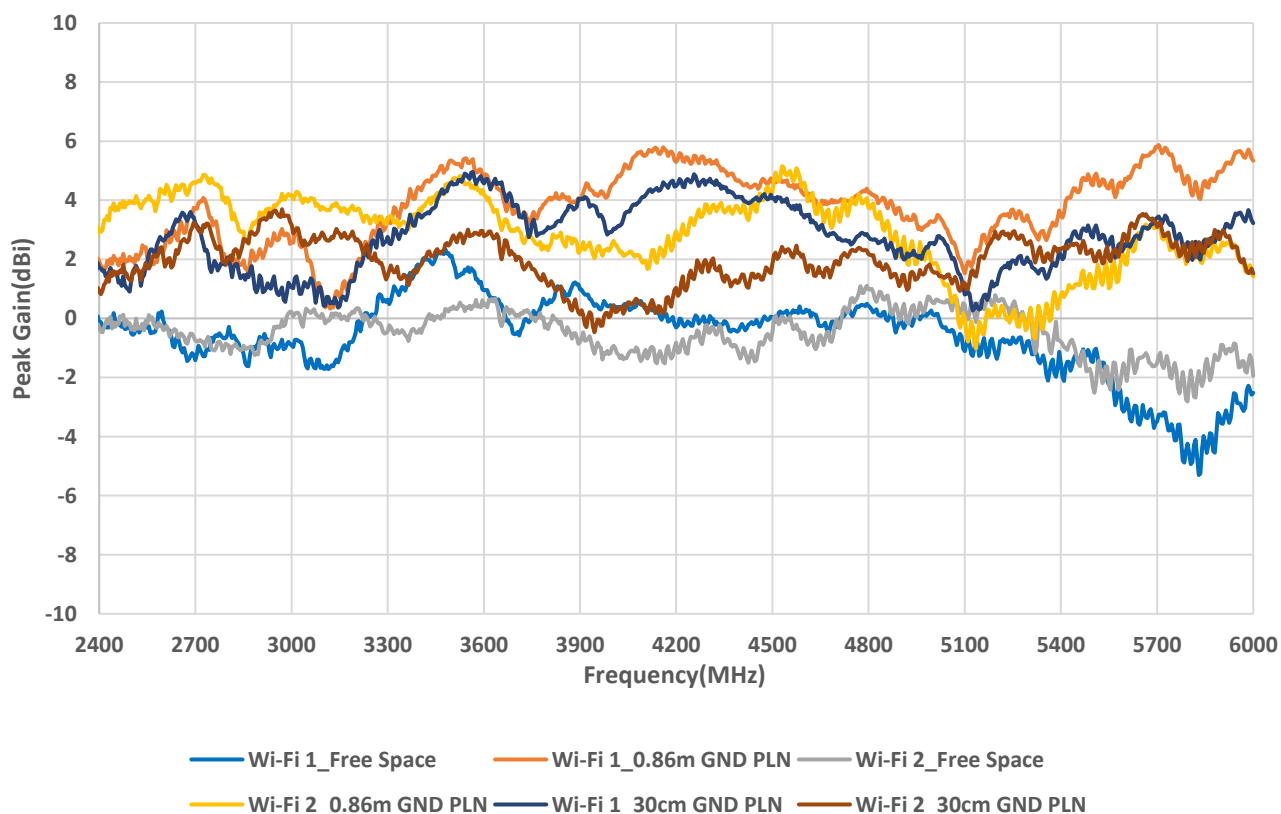


4.4 Peak Gain

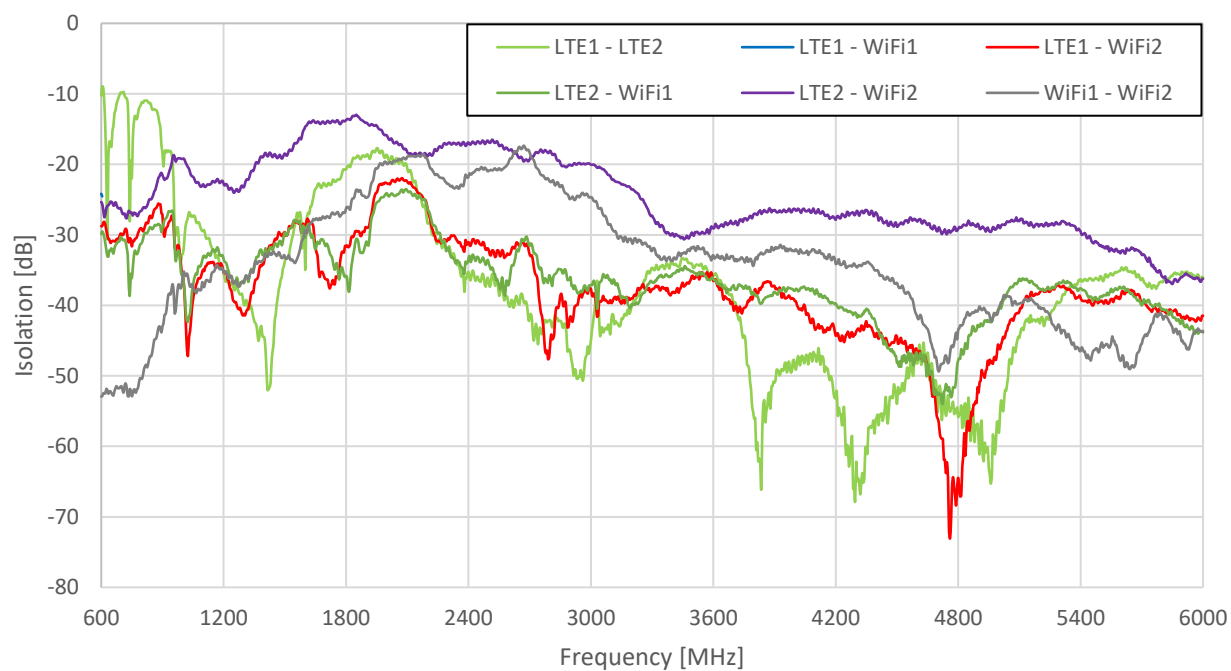
5G/4G MIMO



Wi-Fi MIMO

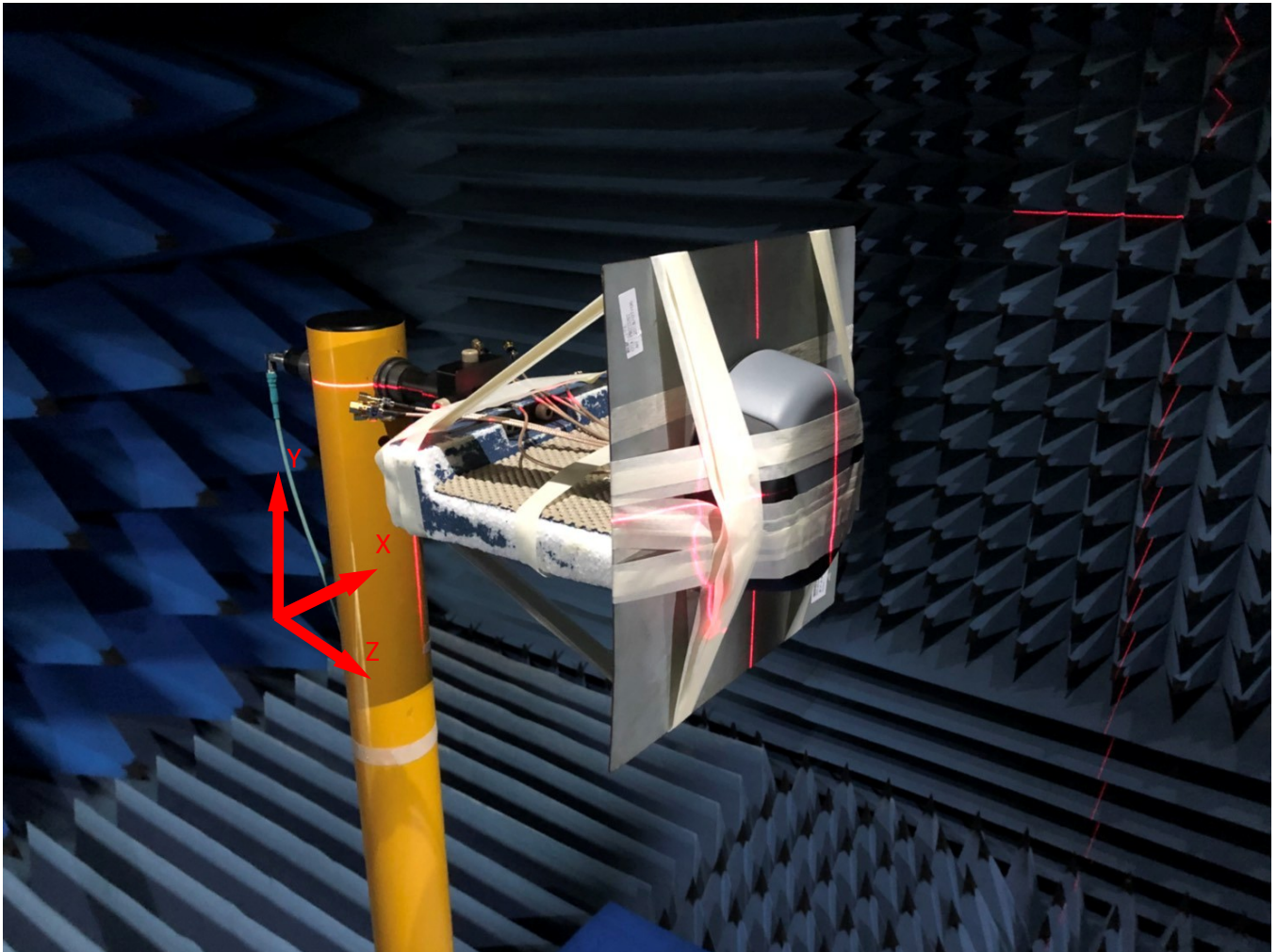


4.5 Isolation



5. Radiation Patterns

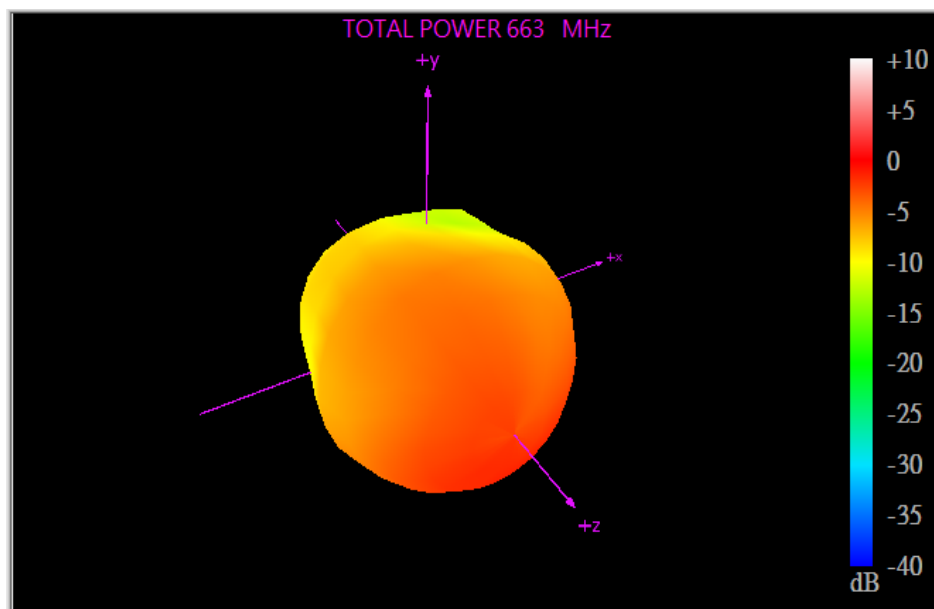
5.1 Test Setup



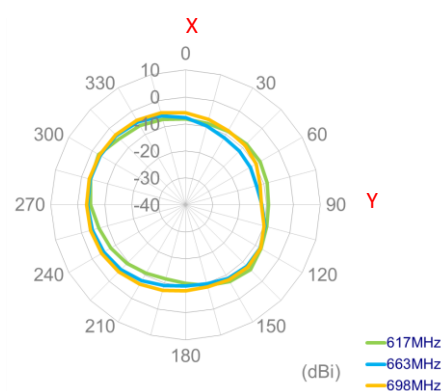
On 30x30cm Ground Plane

5.2 5G/4G MIMO 1 Radiation Pattern

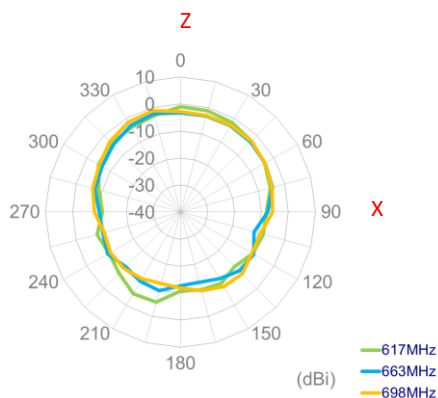
663MHz



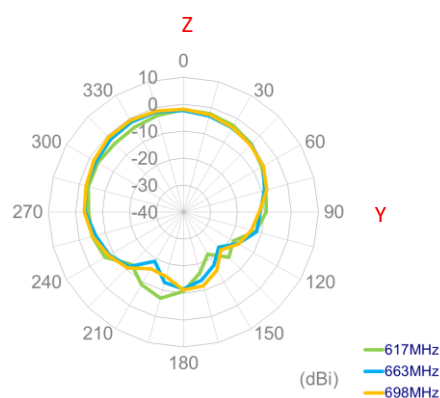
XY Plane



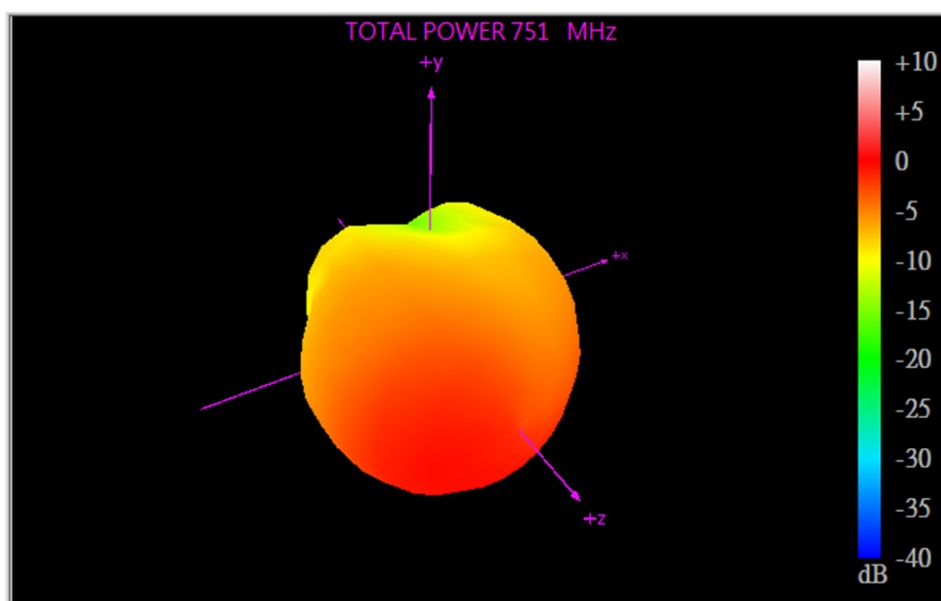
XZ Plane



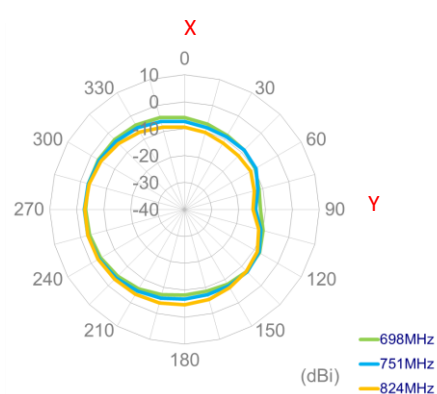
YZ Plane



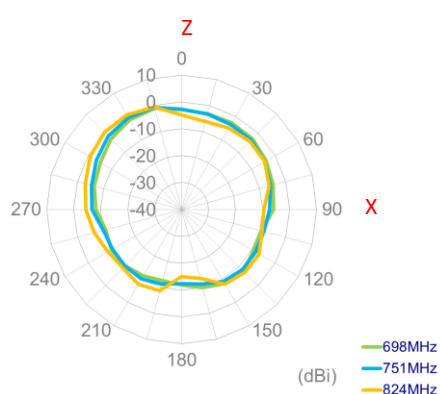
751MHz



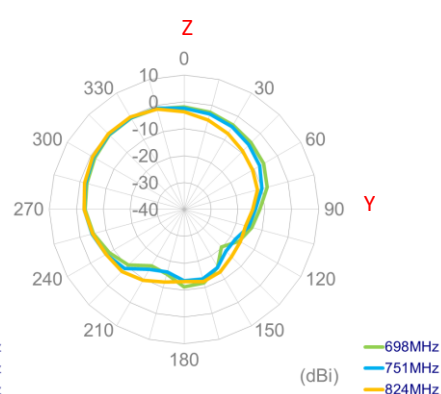
XY Plane



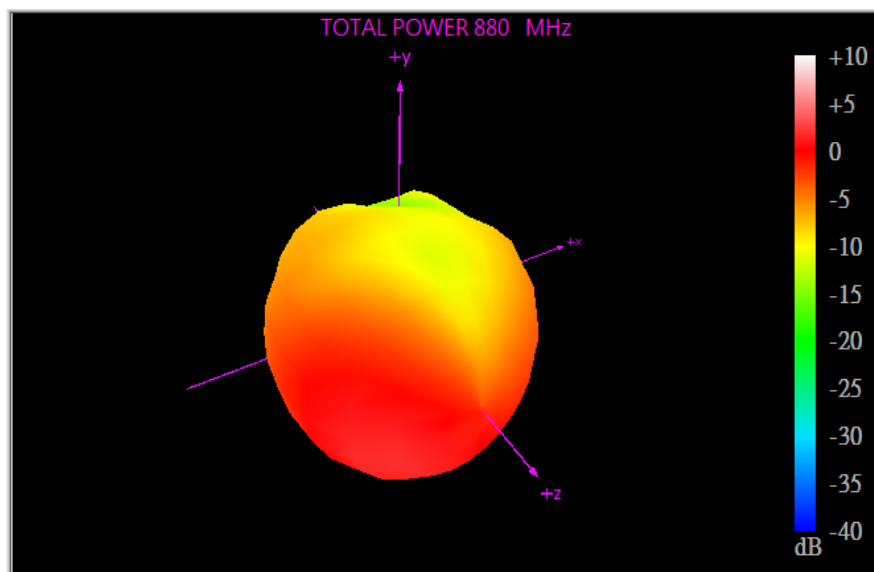
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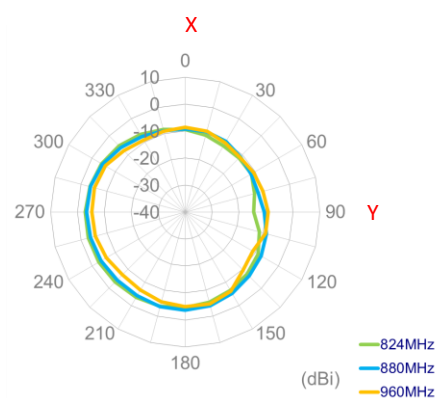
YZ Plane



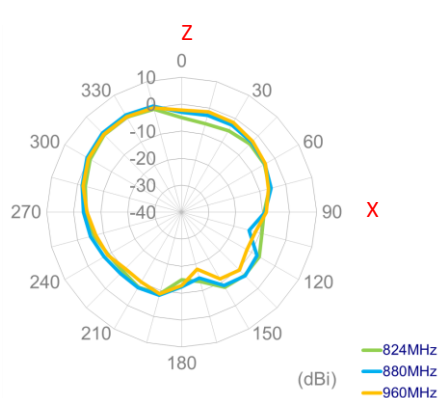
880MHz



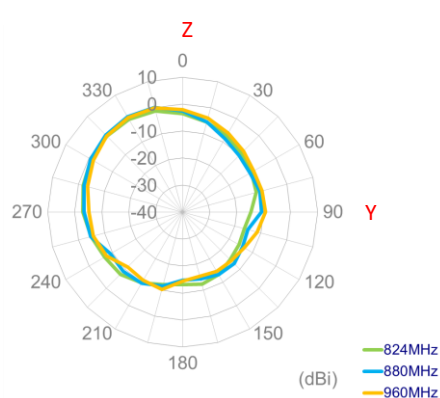
XY Plane



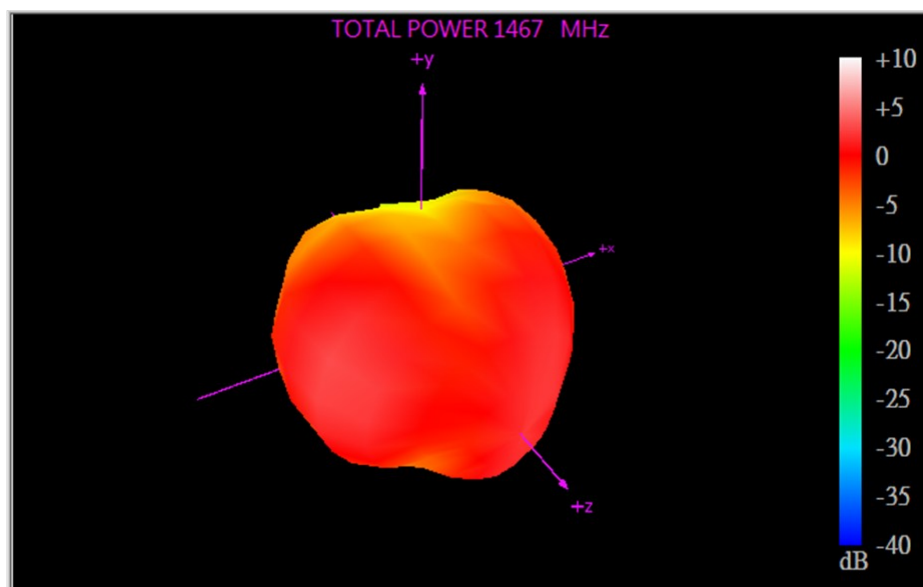
XZ Plane



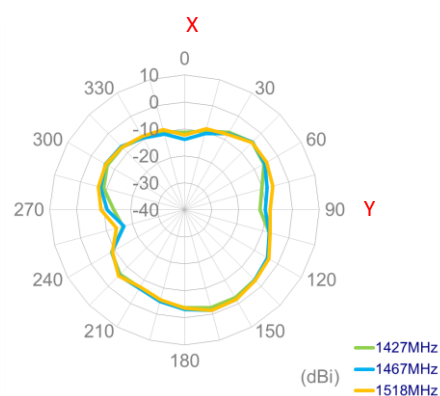
YZ Plane



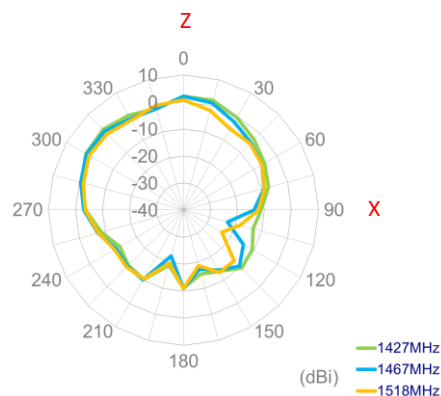
1467MHz



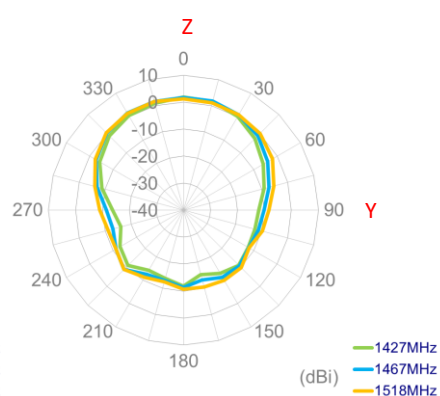
XY Plane



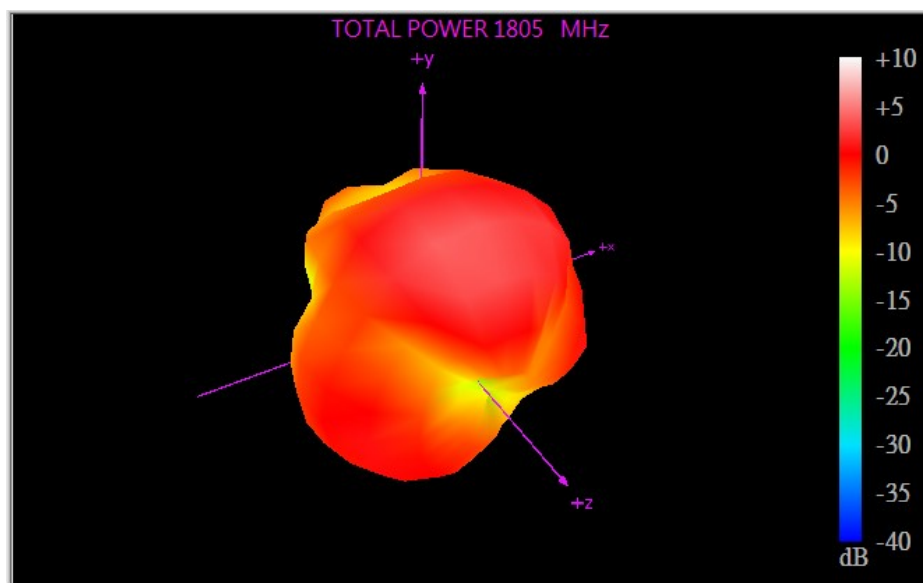
XZ Plane



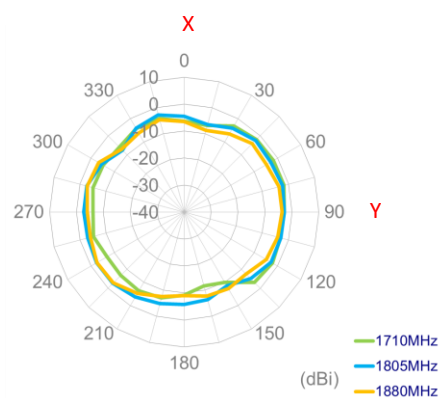
YZ Plane



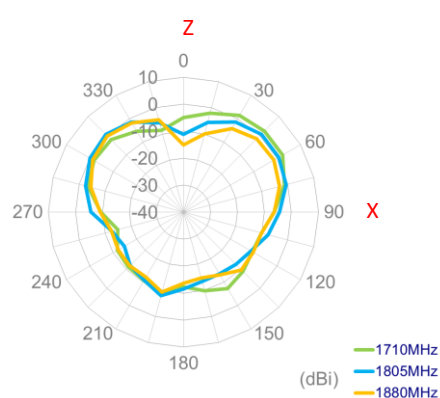
1805MHz



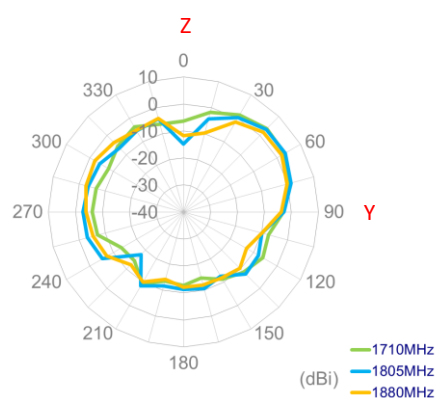
XY Plane



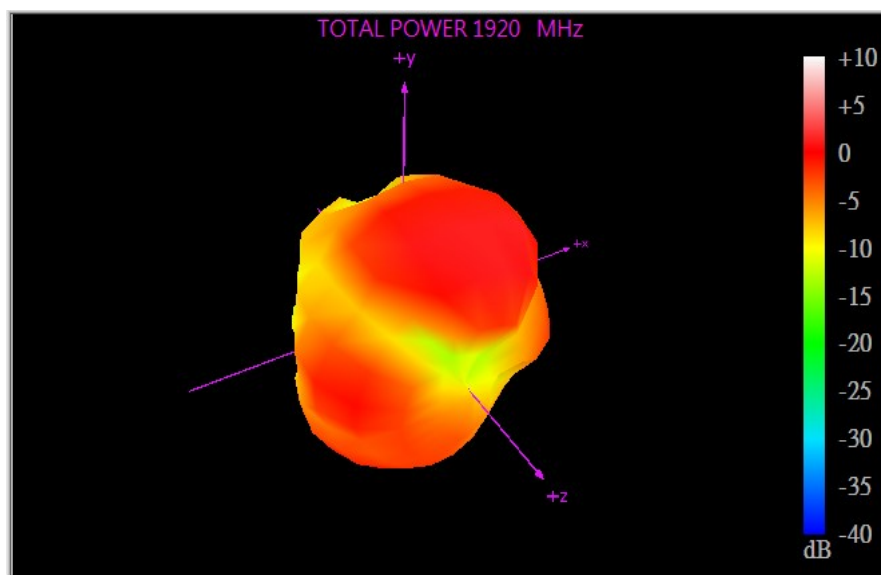
XZ Plane



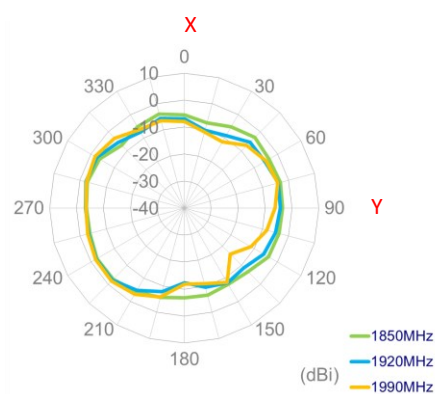
YZ Plane



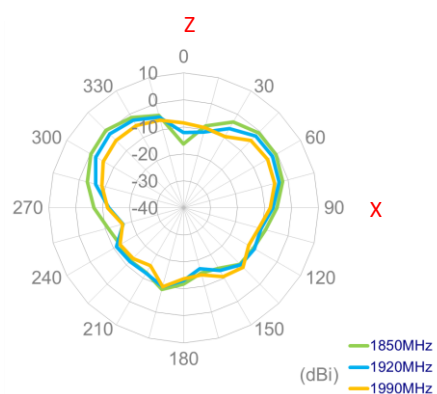
1920MHz



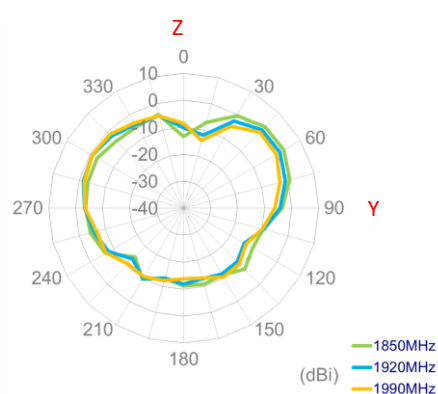
XY Plane



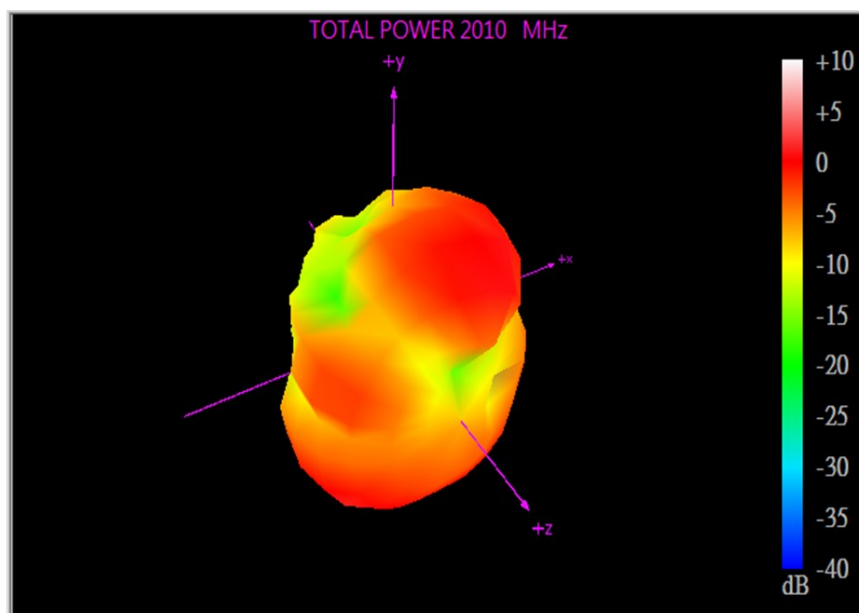
XZ Plane



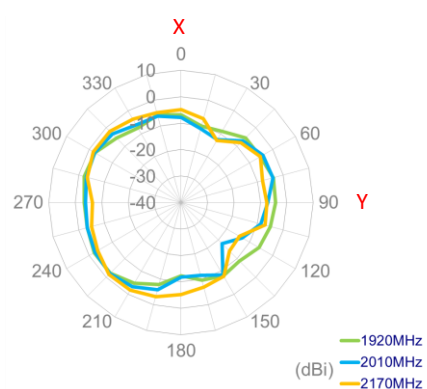
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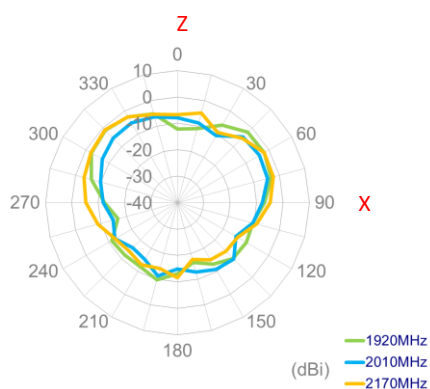
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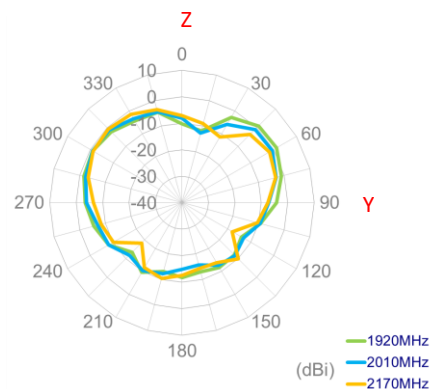
XY Plane



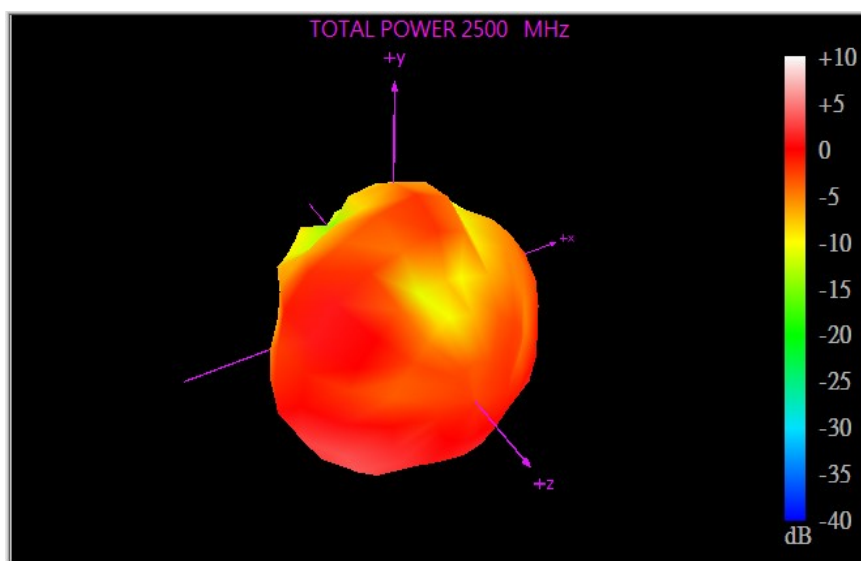
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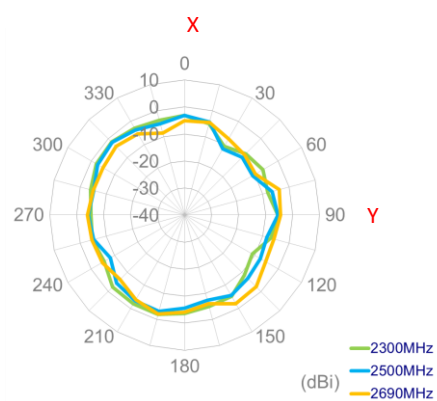
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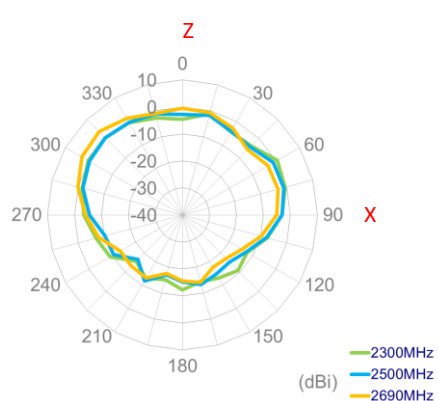
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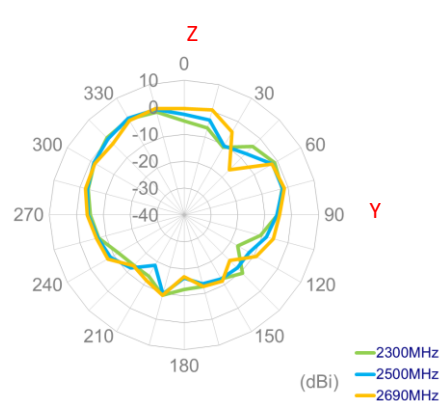
XY Plane



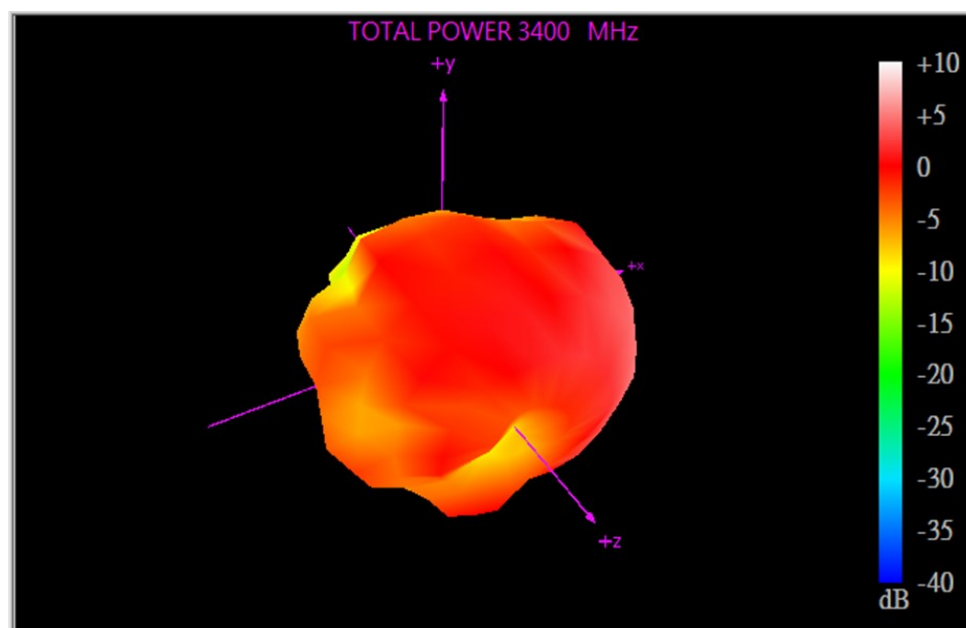
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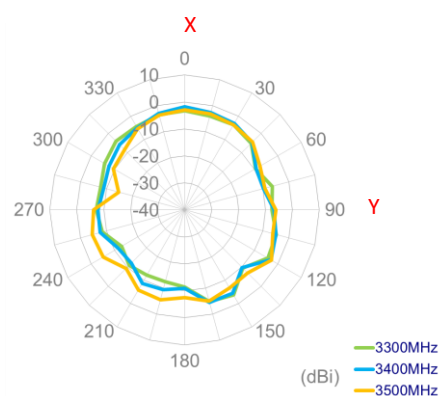
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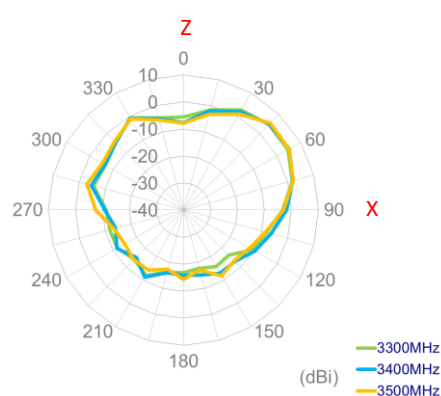
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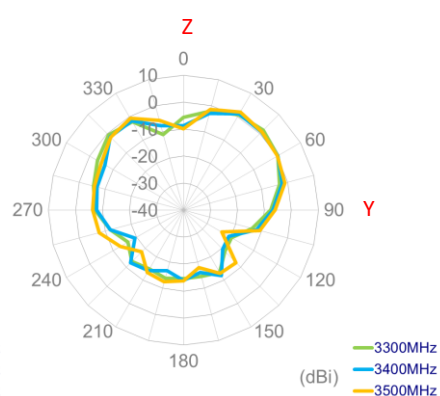
XY Plane



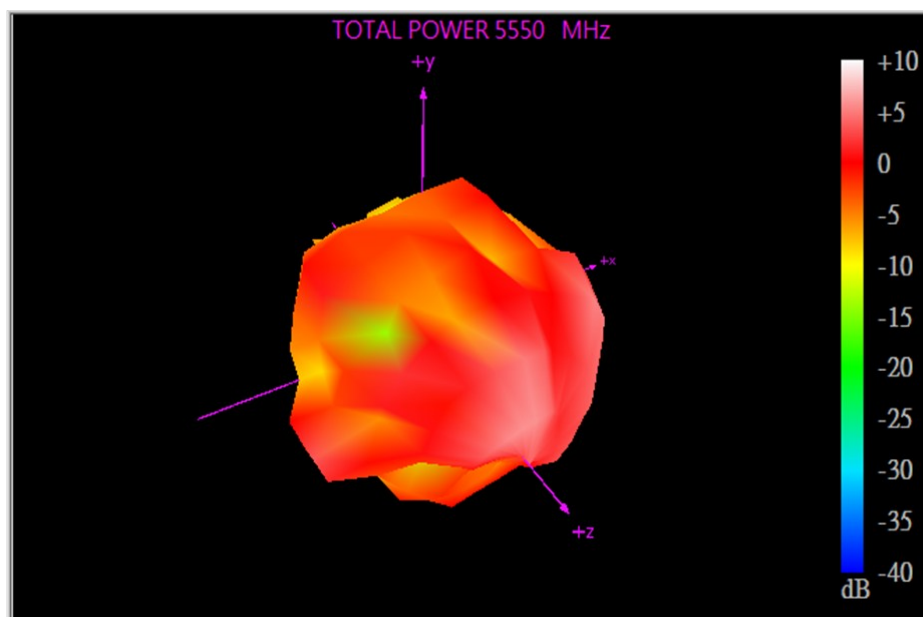
XZ Plane



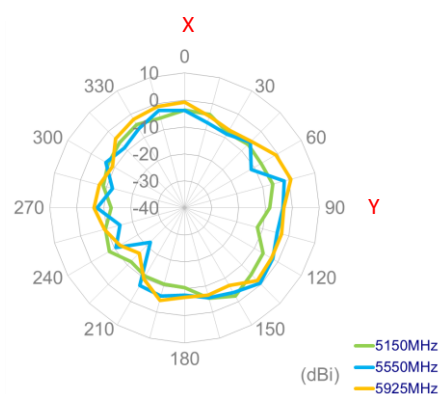
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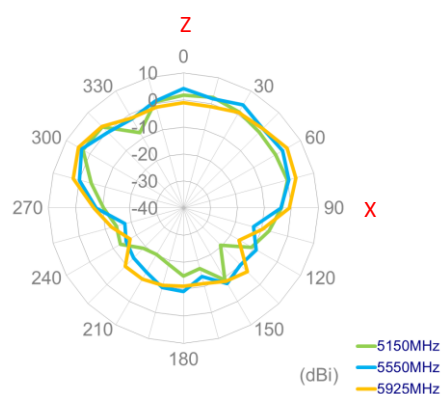
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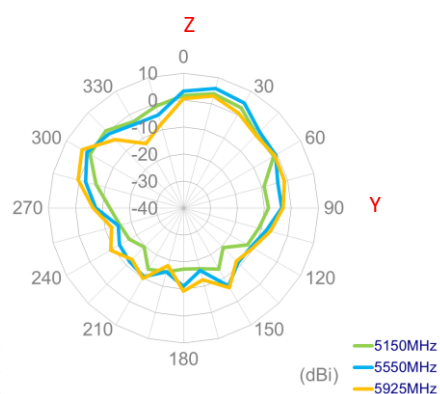
XY Plane



XZ Plane

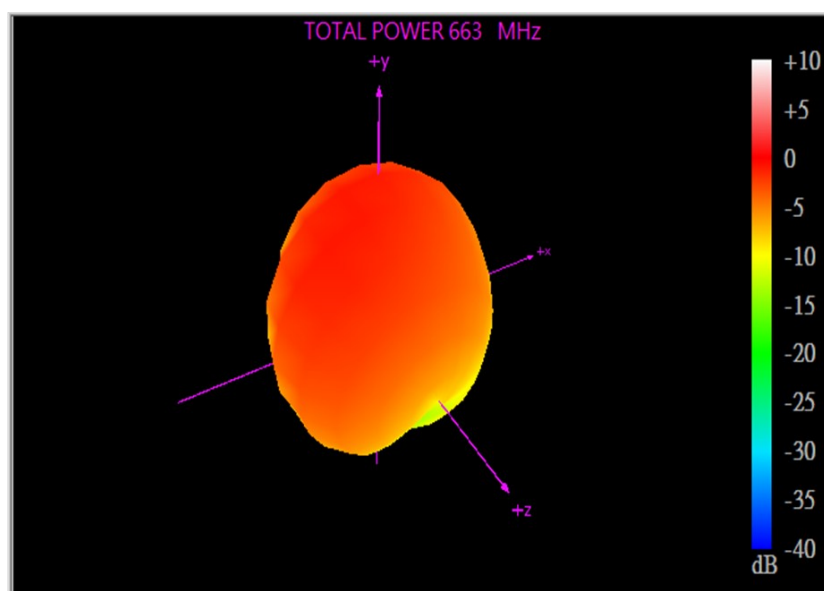


YZ Plane

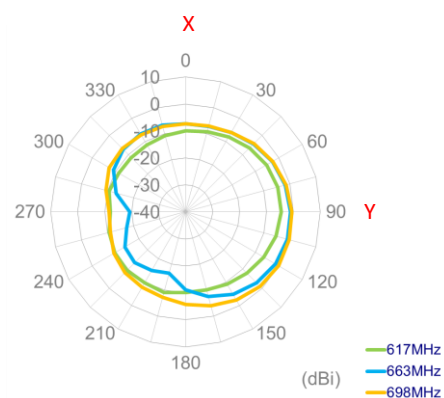


5.3 5G/4G MIMO 2 Radiation Pattern

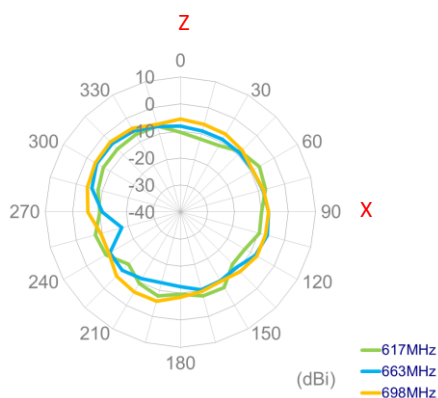
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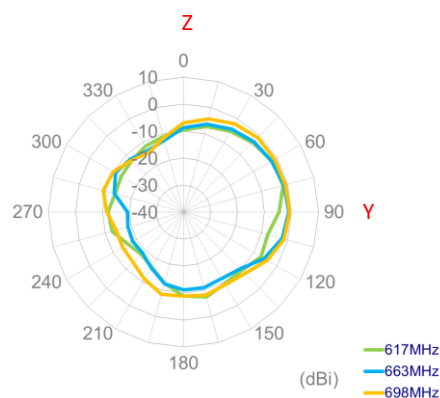
XY Plane



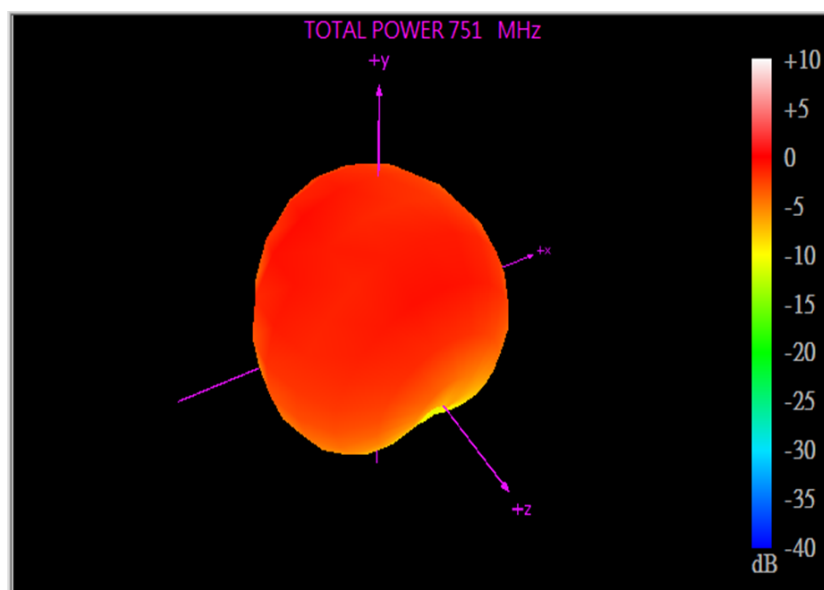
XZ Plane



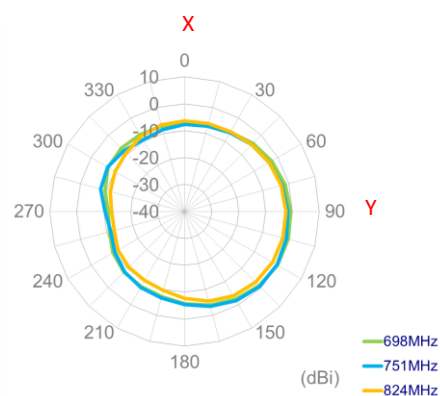
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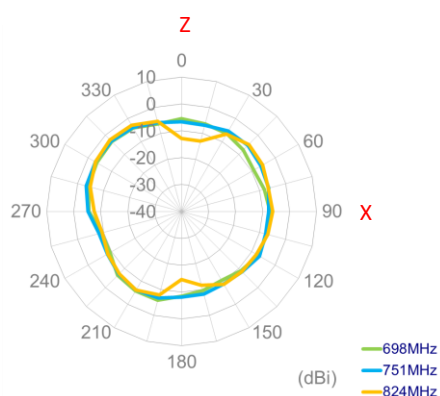
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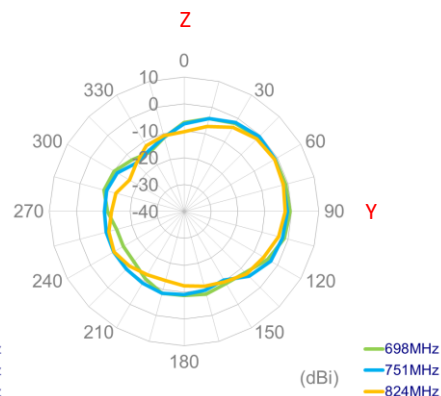
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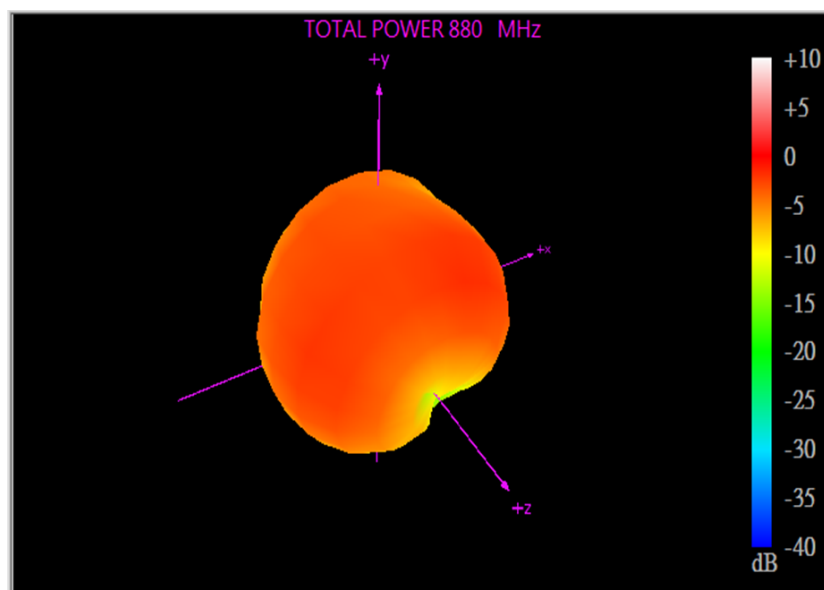
XZ Plane



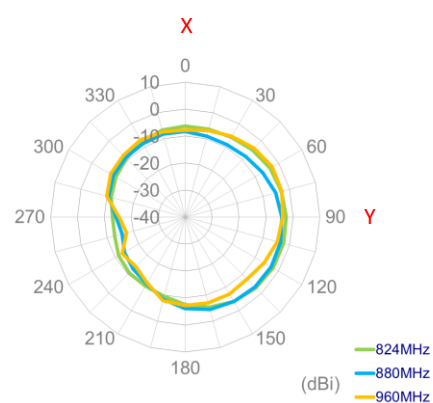
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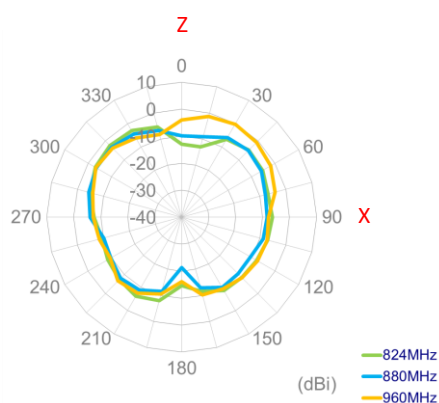
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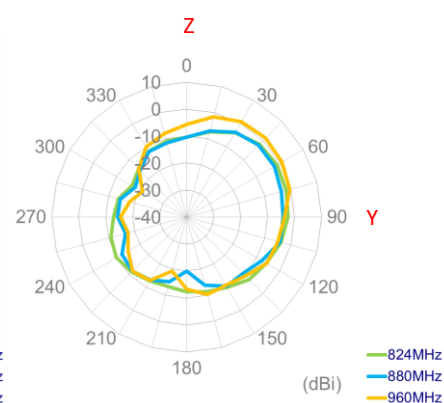
XY Plane



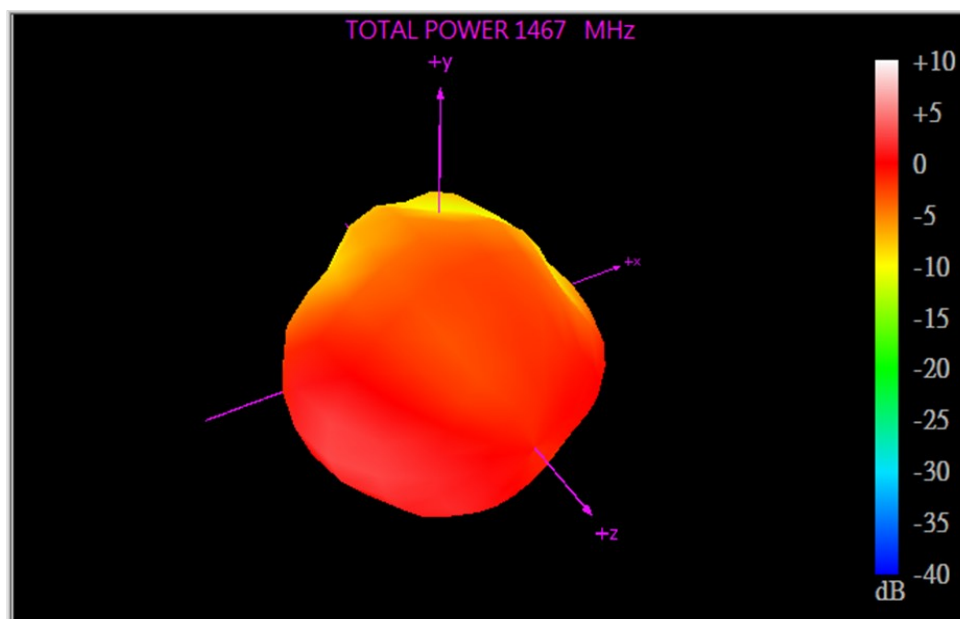
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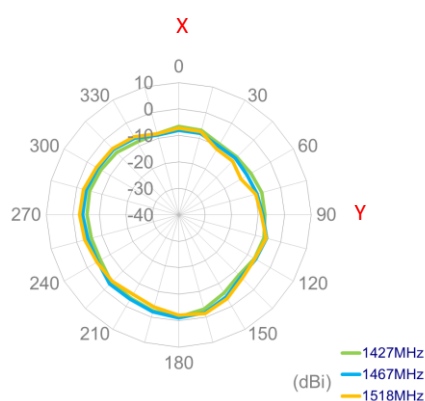
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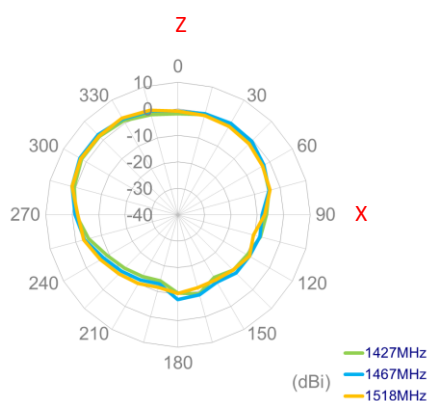
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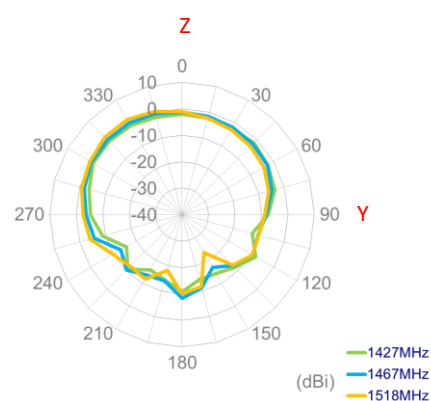
XY Plane



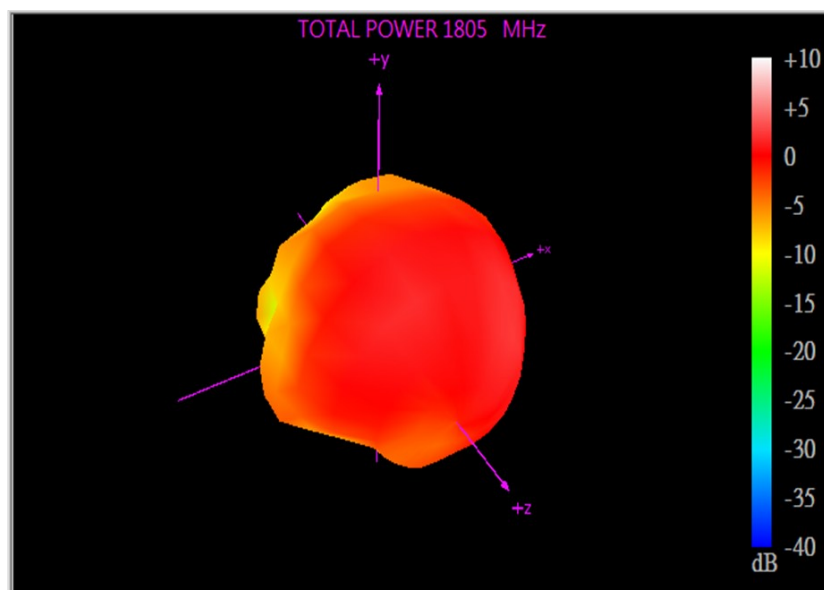
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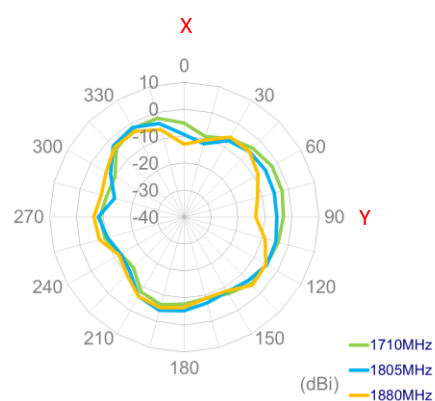
YZ Plane



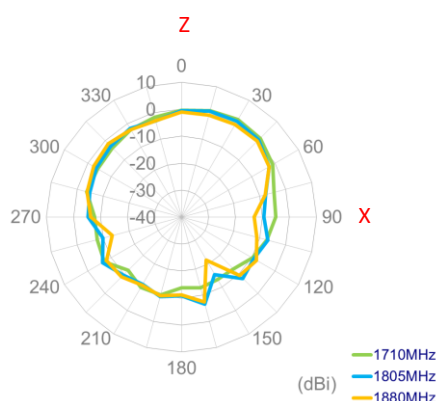
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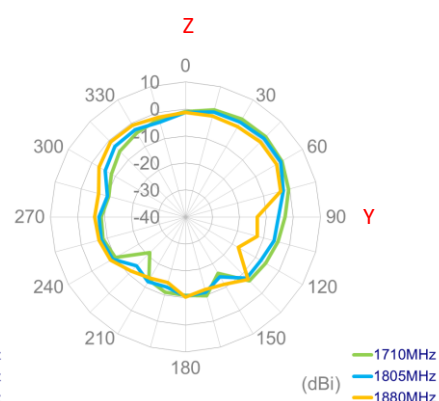
XY Plane



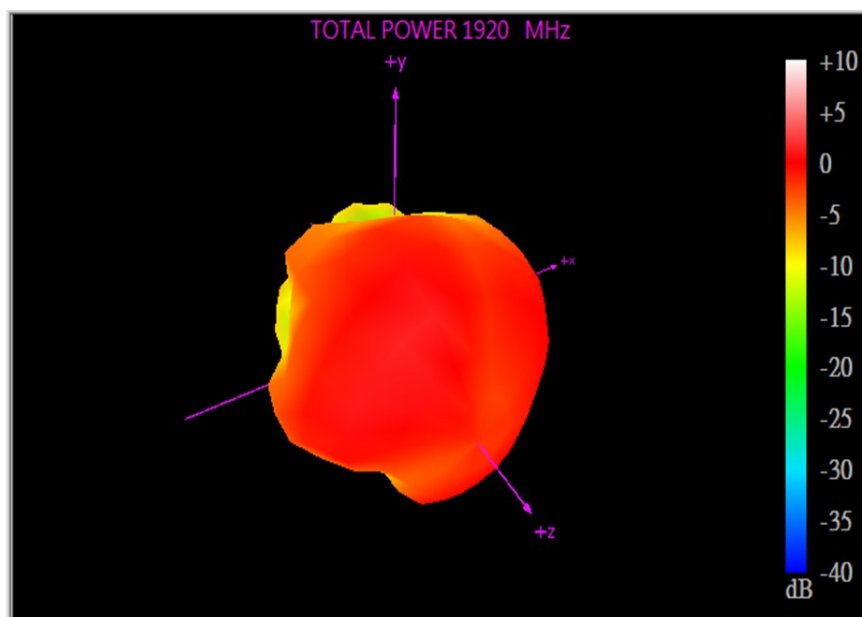
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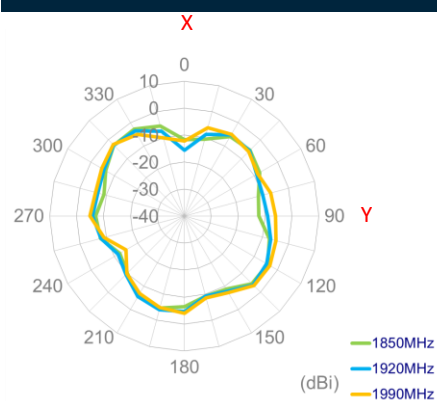
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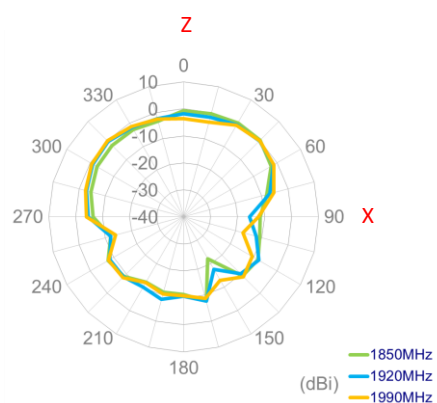
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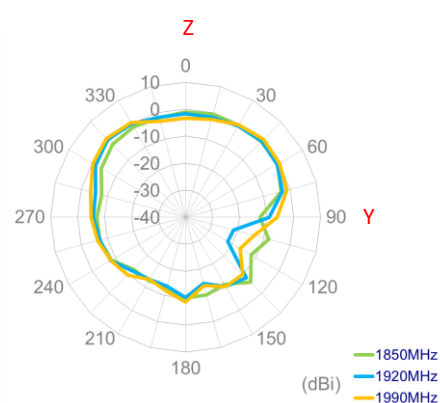
XY Plane



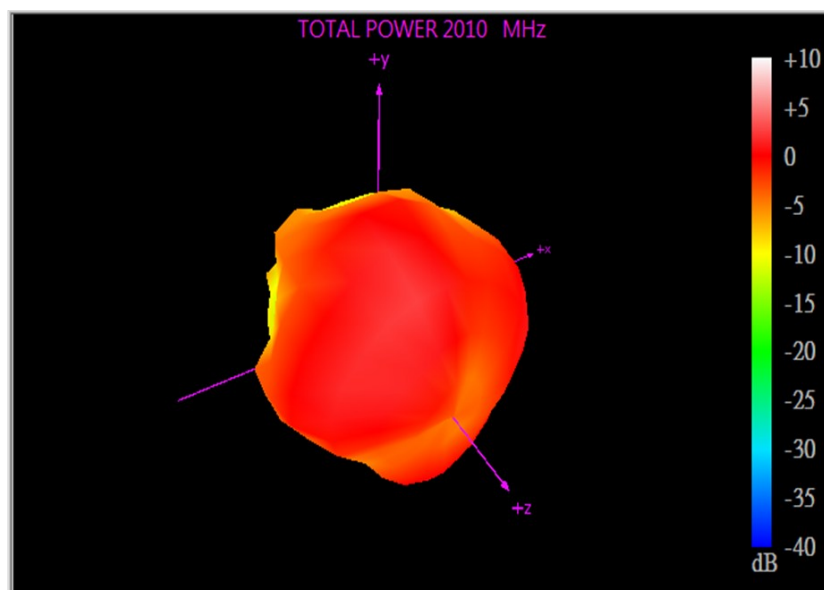
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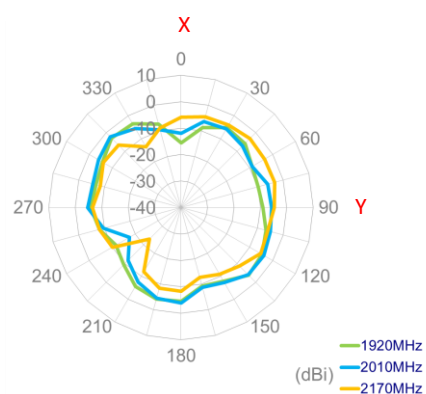
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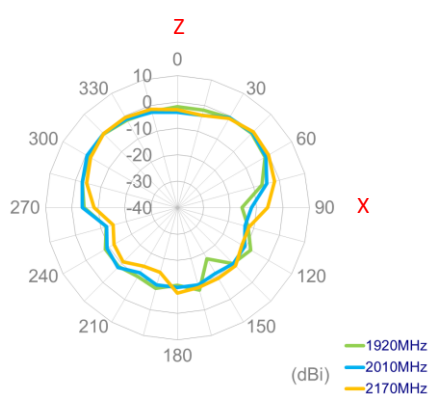
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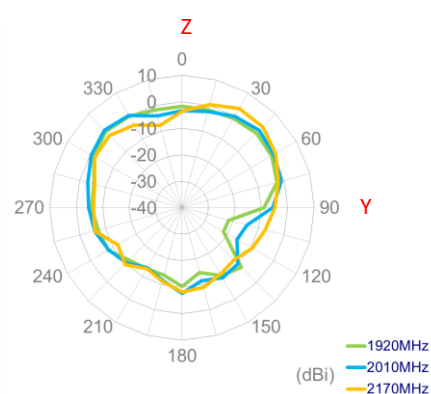
XY Plane



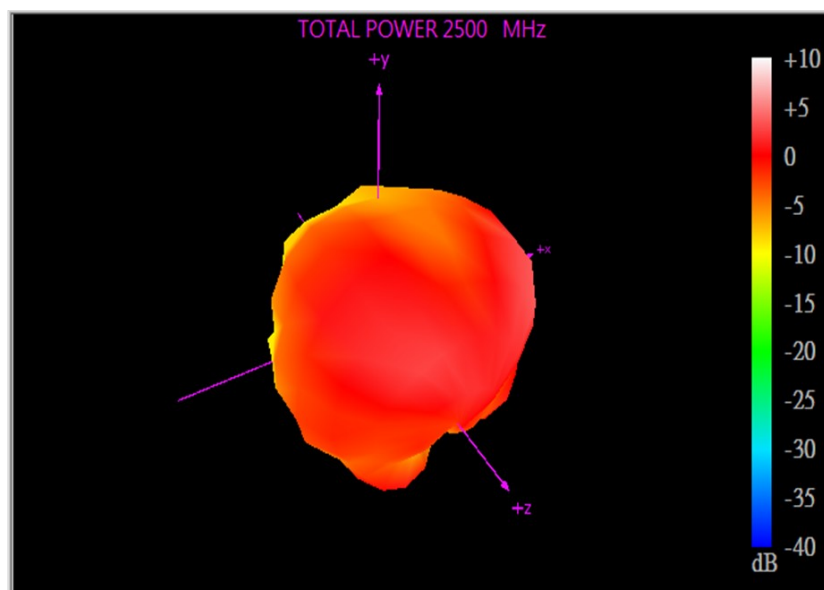
XZ Plane



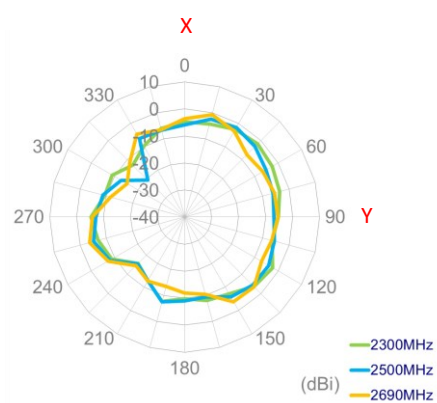
YZ Plane



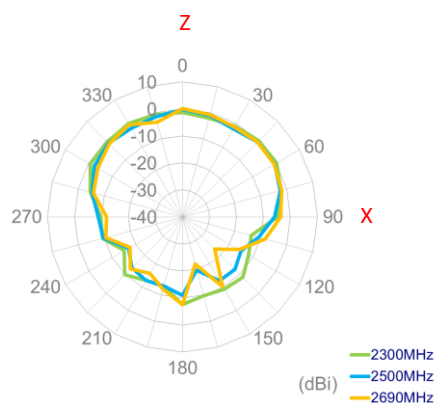
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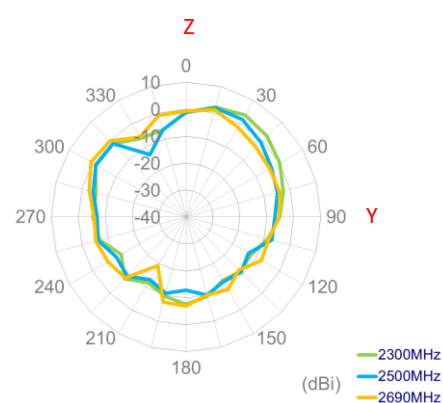
XY Plane



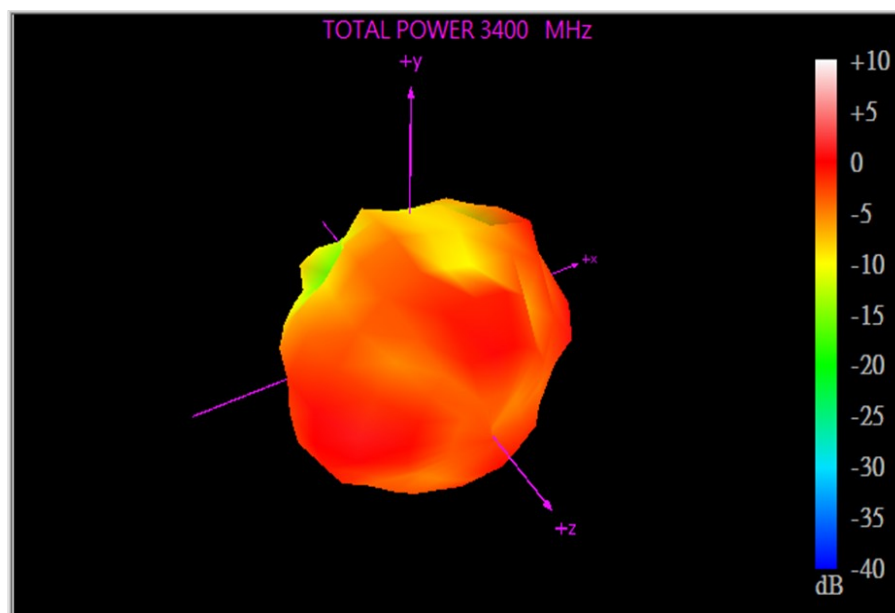
XZ Plane



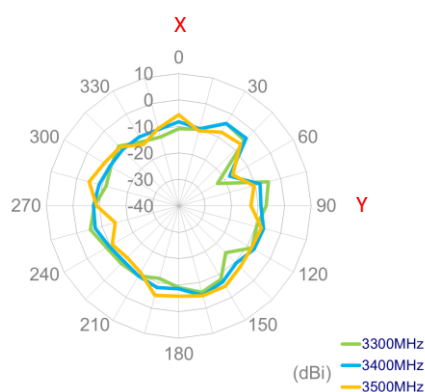
YZ Plane



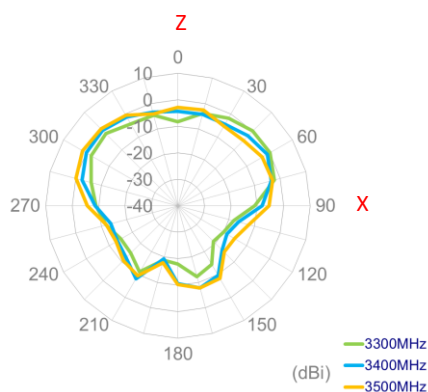
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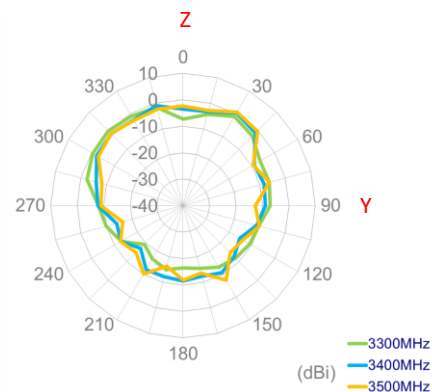
XY Plane



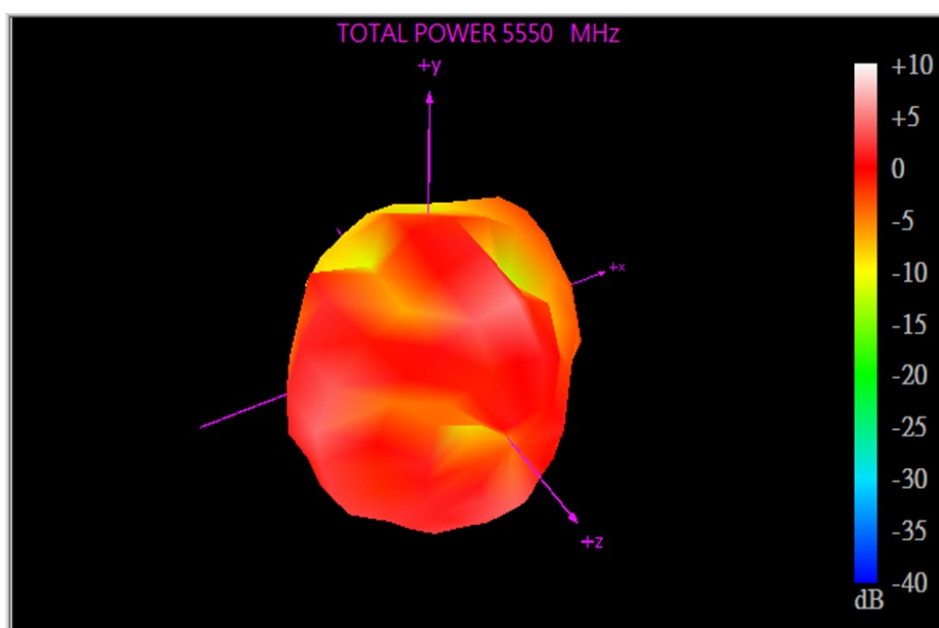
XZ Plane



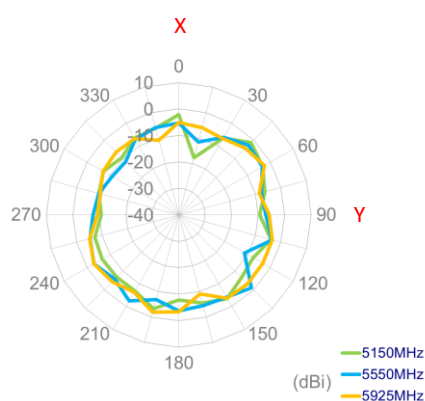
YZ Plane



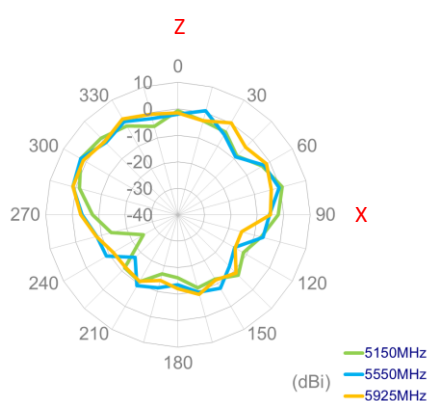
5550MHz



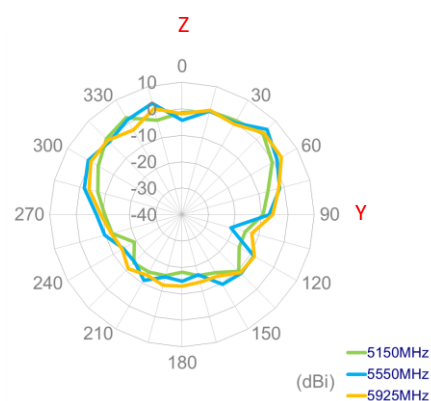
XY Plane



XZ Plane

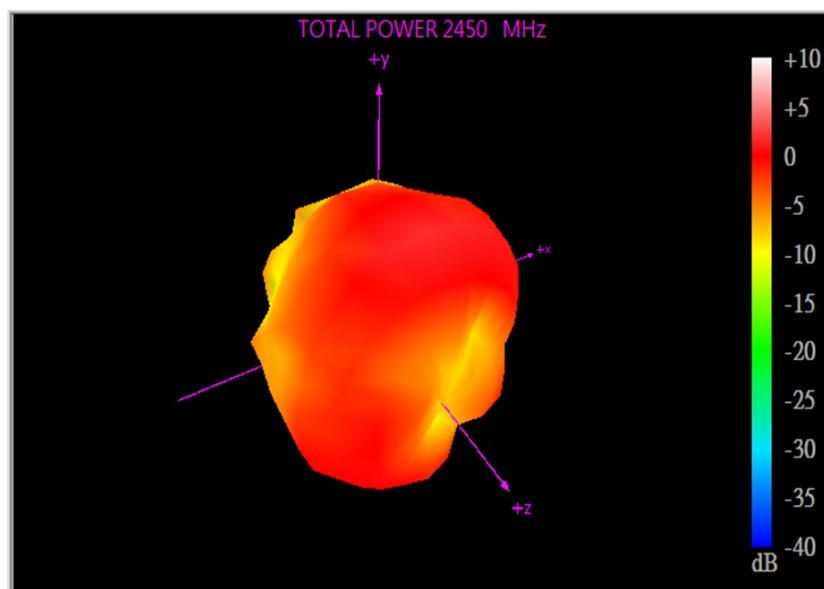


YZ Plane

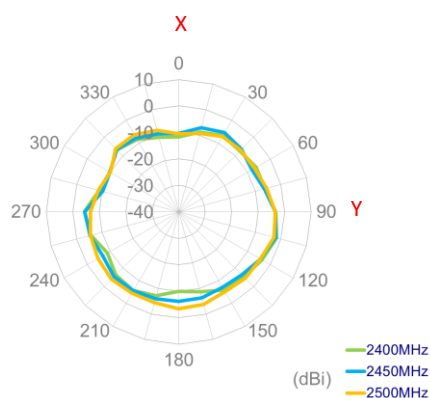


5.4 Wi-Fi MIMO 1 Radiation Pattern

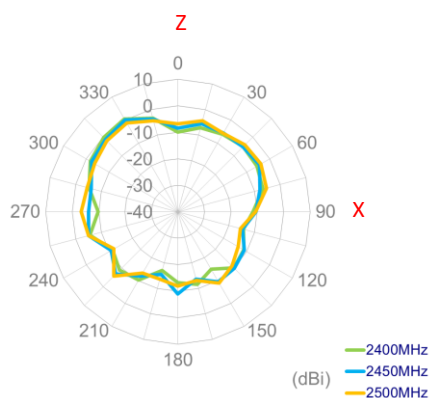
2450MHz



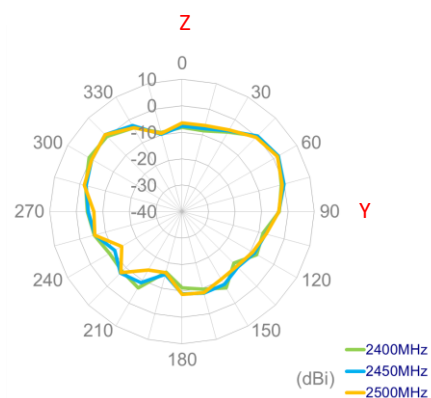
XY Plane



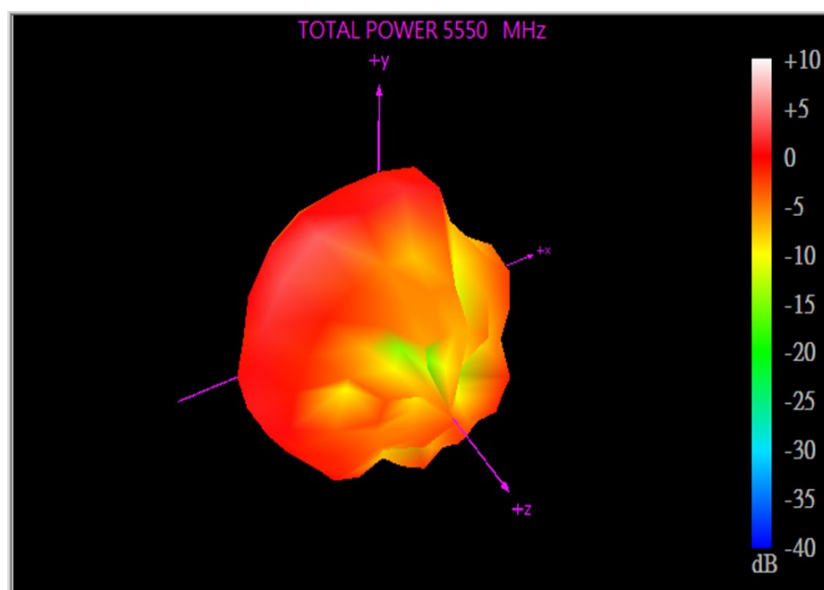
XZ Plane



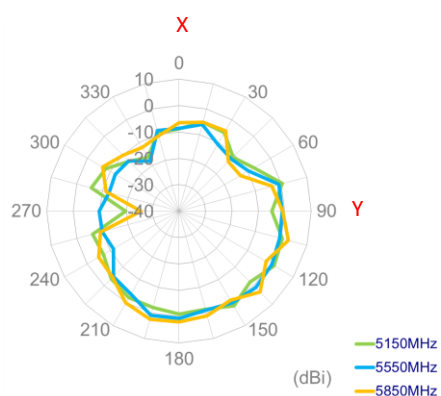
YZ Plane



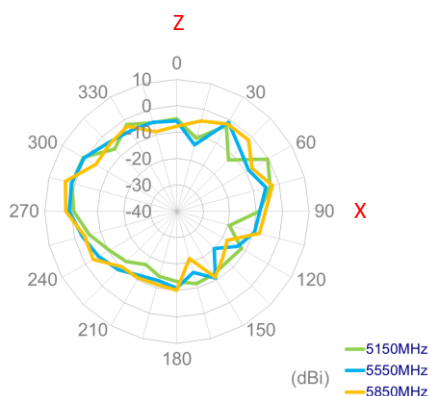
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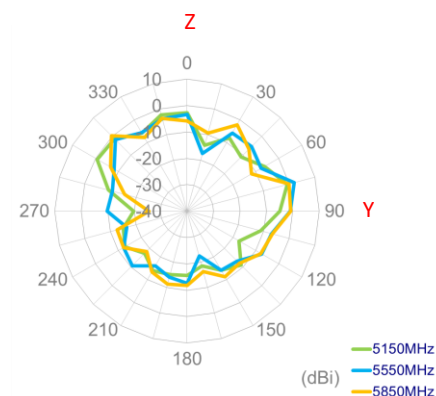
XY Plane



XZ Plane

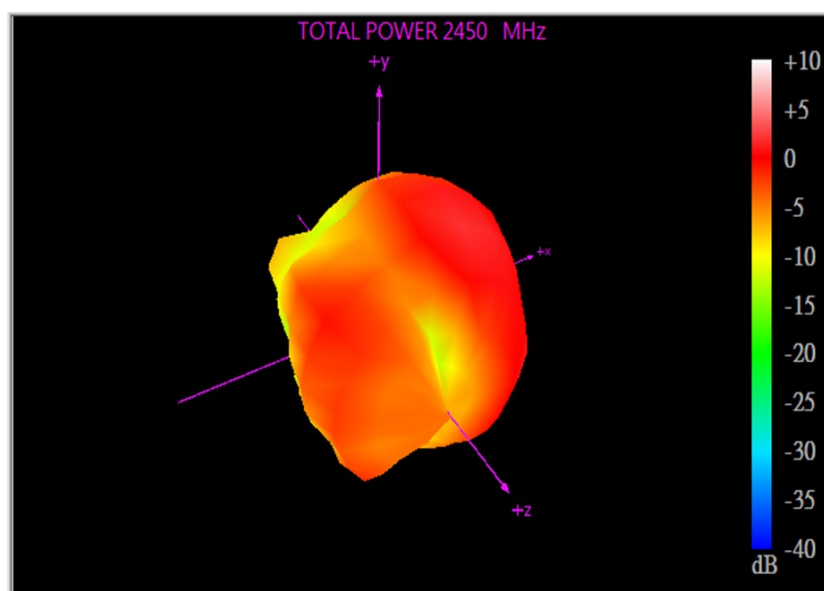


YZ Plane

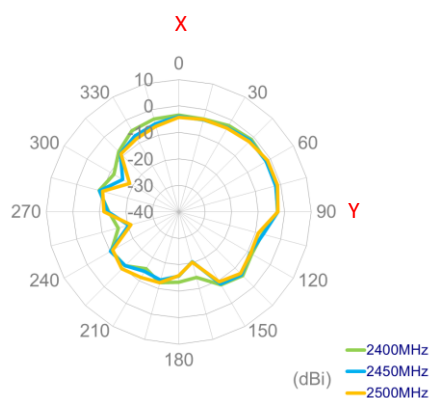


5.5 Wi-Fi MIMO 2 Radiation Pattern

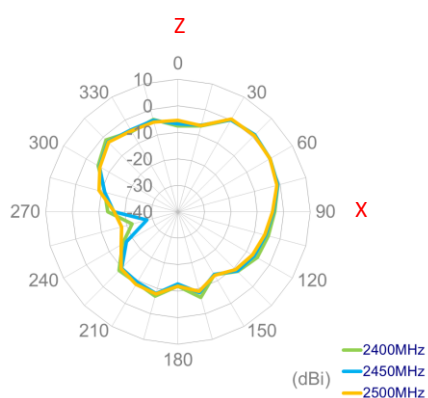
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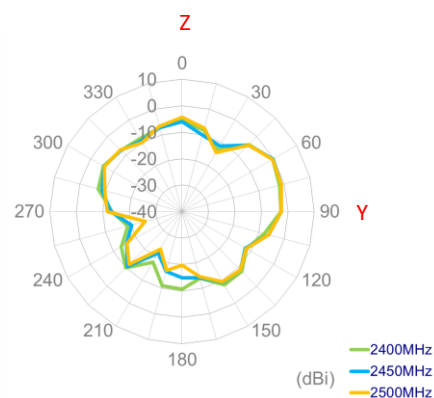
XY Plane



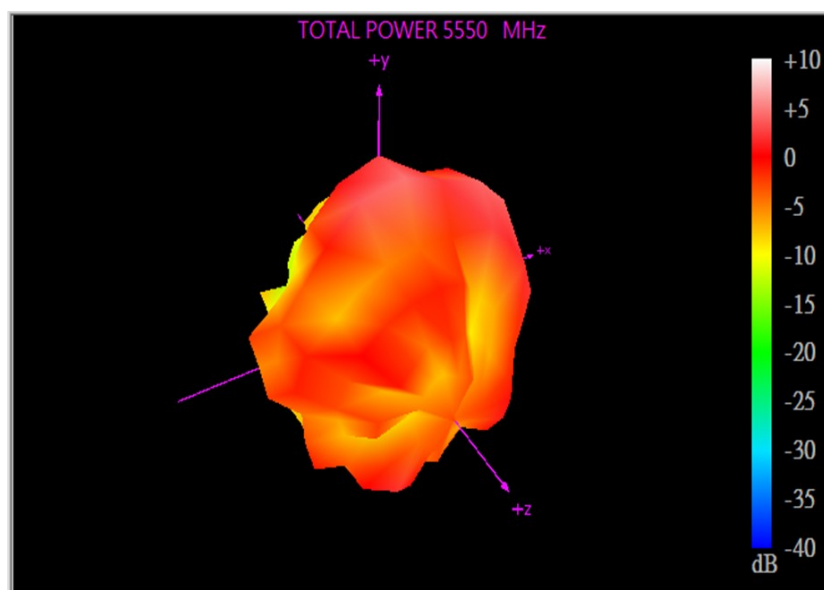
XZ Plane



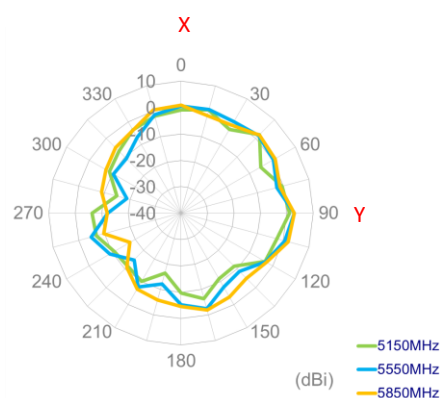
YZ Plane



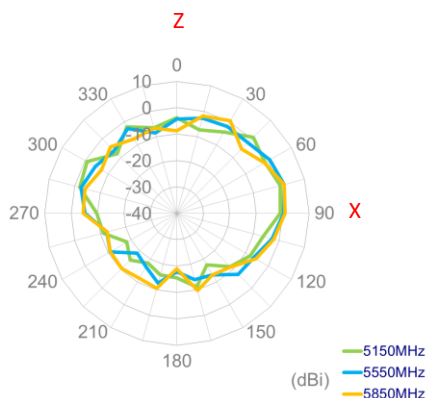
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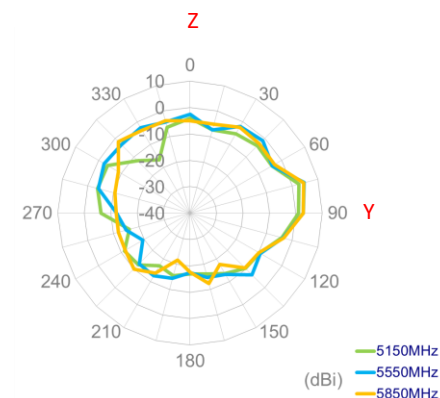
XY Plane

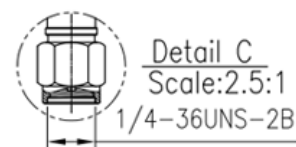
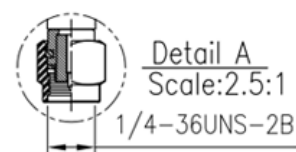


XZ Plane



YZ Plane





	Name	Material	Finish
1	Top Plastic Shell	PC	Black / Grey
2	Bottom Plastic	PC	Black
3	Double Sided Adhesive	EK388-W 948 25	Black Foam/White Liner
4	Nut_M22	Nylon	Black
5	Rubber	Silicone Rubber	Black
6	RG174 Coaxial Cable (MA1505A001)	PVC	Black
7	RG174 Coaxial Cable (CAB.0394)	PVC	Black
8	Empty Label	PEPA	White
9	Heat Shrink Tube (GNSS)	PE	Blue Tube/White Text
10	SMA(M)ST for RG-174	Brass	Au Plated
11	TGC-200 Coaxial Cable	PE	Black
12	Heat Shrink Tube (4G/5G-1)	PE	Red Tube/White Text
13	Heat Shrink Tube (4G/5G-2)	PE	Red Tube/White Text
14	Heat Shrink Tube (Wi-Fi-1)	PE	Yellow Tube/Black Text
15	Heat Shrink Tube (Wi-Fi-2)	PE	Yellow Tube/Black Text
16	SMA(M)ST for TGC-200	Brass	Au Plated
17	Centenary Braid	BSPET-FR4	Black
18	Heat Shrink Tube	PE With Glue	Black
19	Heat Shrink Tube	PE With Glue	Black
20	RP-SMA(M)ST for TGC-200	Brass	Au Plated
21	Heat Shrink Tube (4G/5G-1)	PE	Red Tube/White Text
22	Heat Shrink Tube (4G/5G-2)	PE	Red Tube/White Text
23	Heat Shrink Tube (Wi-Fi-1)	PE	Yellow Tube/Black Text
24	Heat Shrink Tube (Wi-Fi-2)	PE	Yellow Tube/Black Text

7. 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.



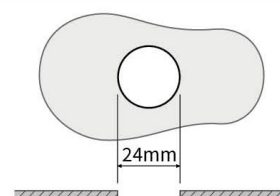
Sealing

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 $\varnothing 24\text{mm}$ ($\frac{7}{8}"$). 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



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.



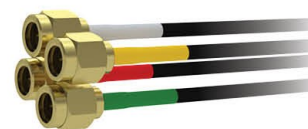
E Securing the Mount

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

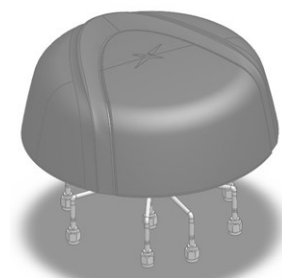
Harmonised Standards and References:

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

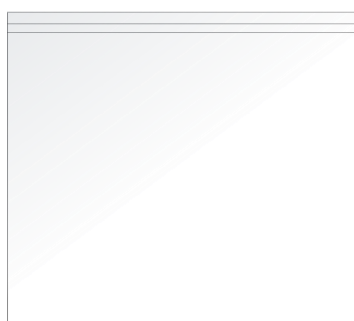
Waiver: This document represents information compiled by Taoglas to the best of our current knowledge. This is not intended to be used as a representation or warranty of fitness of the products described for any particular purpose. This document details guidelines for general information purposes only. When planning installations, always seek specialist advice and ensure that the products are always installed by a properly qualified installer in accordance with applicable regional laws and regulations.

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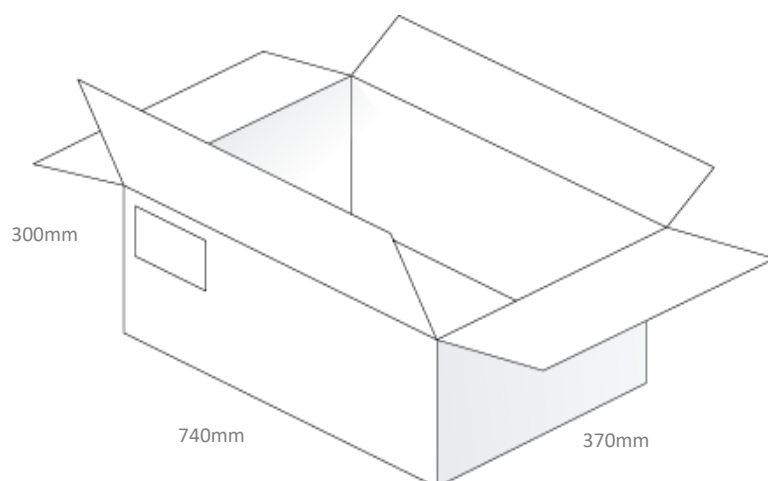
8. Packaging



1pc MA1505.AK.001 per PE Bag
Weight: 2.1Kg



4pcs MA1505.AK.001 per Carton
Carton Dimensions: 740*370*300mm
Weight: 9.3Kg



Changelog for the datasheet

SPE-21-8-055 - MA1505.AK.001

Revision: E (Current Version)

Date:	2025-02-06
Notes:	Added Installation Guidelines
Author:	Cesar Sousa

Previous Revisions

Revision: D

Date:	2024-07-22
Notes:	Updated drawing
Author:	Conor McGrath

Revision: C

Date:	2023-06-13
Notes:	Mechanical specification updated
Author:	Cesar Sousa

Revision: B

Date:	2022-04-05
Notes:	Added isolation graph
Author:	Gary West

Revision: A (Original First Release)

Date:	2021-08-10
Notes:	Initial Release
Author:	Gary West



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